Development of a smoking cessation smartphone application for pregnant smokers focusing on the role of identity

by

Ildiko Tombor

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Research Department of Epidemiology and Public Health

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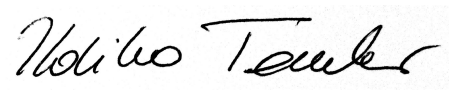
DECLARATION

I, Ildiko Tombor, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.



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ABSTRACT

This thesis reports two strands of work leading to the creation of a smartphone application harnessing identity change to promote smoking cessation during pregnancy. The first strand studied the role of smoker identity in smoking cessation. Using data from a national prospective study of smokers in England, Study 1 found that most young women do not have a positive smoker identity but that those who do are less likely to try to quit smoking, independent of other smoking-related attitudes. Study 2 used prospective national survey data and showed that adopting a non-smoker identity after a quit attempt predicts medium-term abstinence. Study 3 was a meta-ethnography of smoker identity in young adults and found that multiple smoker identities evolve depending on the context and that these do appear to play a role in cessation. The second strand related to the development of the application itself. Using interviews with pregnant smokers, Study 4 found that, from their perspective, stopping smoking would require strong enough motivation, improved ability and a supportive social and physical environment. Study 5 involved focus groups of health professionals working with pregnant smokers and solicited recommendations regarding the design and delivery of digital cessation aids in pregnancy. Study 6 used data from a pilot randomised controlled trial of the smoking cessation website, MumsQuit, to assess associations between exposure to particular components and four-week continuous abstinence. Six behaviour change techniques were associated with abstinence: promoting problem solving, providing feedback on behaviour, promoting self-monitoring of outcomes of the behaviour, providing feedback on outcomes of the behaviour, providing social reward, and promoting self-reward. The thesis concludes with a description of the development of a smartphone application, SmokeFree Baby, based on preceding work.

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LIST OF ABBREVIATIONS

ADHD – Attention Deficit Hyperactivity Disorder

App – Application (software)

BCT – Behaviour Change Technique

BCTTv1 – Behaviour Change Techniques Taxonomy v1

BCW – Behaviour Change Wheel

CNS – Central Nervous System

CO – Carbon Monoxide

COPD – Chronic Obstructive Pulmonary Disease

DA – Dopaminergic

HCP – Health Care Provider

HSI – Heaviness of Smoking Index

IFS – Infant Feeding Survey

MOST – Multiphase Optimization Strategy

MRC – Medical Research Council

MTSS – Motivation To Stop Scale

NAcc – Nucleus Accumbens

nAChR – Nicotinic Acetylcholine Receptor

NCSCT – National Centre for Smoking Cessation and Training

NHS – National Health Service

NRT – Nicotine Replacement Therapy

NICE – National Institute for Health and Care Excellence

RCT – Randomised Controlled Trial

SATOD – Smoking Status At Time Of Delivery

SMART – Sequential Multiple Assignment Randomized Trial

SF28 – SmokeFree28

UCL – University College London

VTA – Ventral Tegmental Area

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CHAPTER 1 – GENERAL INTRODUCTION

1.1. Smoking prevalence in the general population

Since the introduction of tobacco into Europe in the late 1400s, it has spread across the globe and has been consumed in many different forms, including combustible products, such as bidis, cigars and cigarettes, and smokeless tobacco, such as snus, snuff and chewing tobacco (Courtwright, 2001). Smokeless tobacco use is most prevalent in countries like India, Bangladesh, Norway or Sweden, but the majority of people around the world smoke manufactured cigarettes (Eriksen et al., 2012, Giovino et al., 2012). The prevalence of daily smoking (combustible and smokeless tobacco use combined) has declined globally since 1980, but there are still approximately one billion adult tobacco smokers worldwide (Ng et al., 2014). This thesis focuses solely on combustible tobacco products, predominantly manufactured or 'rolled your own' cigarettes; therefore, the terms 'smokers' and 'smoking' are used in this context throughout, unless otherwise indicated.

Changes in smoking prevalence in the UK are similar to the global patterns, as the General Lifestyle Survey (formerly the General Household Survey) has recorded a declining trend since the mid 1970s (Dunstan, 2012). In 2013, data from the Smoking Toolkit Study (www.smokinginengland.info) showed a historically low overall smoking prevalence of 19.3% in a nationally representative sample of adults age 16 and over in England (Brown and West, 2014). The country is in the last stage of the tobacco epidemic (Lopez et al., 1994), and as such it can be characterised with a slightly slower (average 0.6% per year) decline in prevalence (Brown and West, 2014). As the vast majority of adult smokers in England smoke

cigarettes on a daily basis (Herbec et al., 2014c) – 12 cigarettes per day on average (West and Brown, 2012) – the prevalence of non-daily smoking is relatively low (approximately 2%) in the country (Herbec et al., 2014c).

Generally, the proportion of smokers is higher in men than women (Ng et al., 2014). Although there is a considerable variation between countries, the gender difference in smoking prevalence tends to be relatively low in Western industrialised countries, including the USA, Australia, New Zealand and countries in north-western Europe (Ng et al., 2014). In England, the difference between the proportion of men and women smokers has narrowed to 20.1% and 17.0%, respectively (unpublished data from the Smoking Toolkit Study, 2014). Worryingly, as more women start smoking, particularly in low and middle income countries (Eriksen et al., 2012, Giovino et al., 2012) where the tobacco epidemic is typically in its earlier stages (Lopez et al., 1994), it is expected that the overall difference in smoking prevalence between men and women will continue to diminish in the future (Eriksen et al., 2012, Giovino et al., 2012).

The global pattern of age-specific smoking prevalence follows an inverted U-shape curve both in men and women (Ng et al., 2014). In high-income countries, including England, smoking prevalence is relatively low among teenagers, then prevalence increases and peaks in middle age before it begins to decline with older age to reach its lowest level in adults aged 60 and over (Ng et al., 2014, Dunstan, 2012). There are a number of potential mechanisms underlying this pattern. First, most people start smoking before their twenties (Robinson and Harris, 2011), and those who do not start smoking by the age of 26 are less likely to do so later (U.S. Department of Health and Human Services, 2012). Secondly, smoking cessation

rates are higher in young adults and older people than in middle-aged smokers (Fidler et al., 2013). Thirdly, most life-long smokers will die prematurely of a smoking-related disease (Doll et al., 2004).

Smoking contributes greatly to health inequalities, because its prevalence is disproportionately high in low socioeconomic groups (Marmot, 2010). In England, smoking prevalence is almost twice as high among people with low social grades than those with high social grades (25.4% and 12.8%, respectively) (unpublished data from the Smoking Toolkit Study, 2014). In addition, even though smokers from low social grade groups try to stop smoking as many times as those from high social grade groups, their quit attempts appear to be less successful (Kotz and West, 2009), and they are less likely to quit at a younger age (Fidler et al., 2013) when much of the damage caused by smoking can still be avoided (Doll et al., 2004). Nevertheless, a positive association between high social grade and quit success appears to be more specific to the UK than other Western countries (Vangeli et al., 2011).

1.2. Smoking and health

Tobacco smoking is the main preventable cause of premature death and ill health (Eriksen et al., 2012), and it leads to approximately 6 million deaths worldwide annually (World Health Organization, 2013). In England alone, it is estimated that over 79,000 people die each year as a result of smoking that represents one fifth of all deaths of people age 35 and over in the country (NHS Information Centre, 2012). There is strong evidence to support that life-long smoking shortens life expectancy by 9-10 years (Doll et al., 2004, Jha et al., 2006, Pirie et al., 2013, Sakata et al., 2012, Strandberg et al., 2008), and that smokers also lose about a decade

of their quality-adjusted life years (Bronnum-Hansen et al., 2007, Jia et al., 2013). Due to the extensive harmful effects of smoking on the body and on overall health (U.S. Department of Health and Human Services, 2004), life-long smokers not only live shorter regardless of gender and social position (Gruer et al., 2009), but they experience worse health-related quality of life (Strandberg et al., 2008).

The major contributors to smoking-attributable deaths include lung cancer, chronic obstructive pulmonary disease (COPD) and coronary heart disease (NHS Information Centre, 2012, U.S. Department of Health and Human Services, 2014). Over and above these, the list of conditions with sufficient evidence of being caused by smoking has been continuously expanding in recent decades (U.S. Department of Health and Human Services, 2014, U.S. Department of Health and Human Services, 2004). The 2014 Surgeon General's report concludes that smoking is causally associated with at least 15 different types of cancer (e.g. oropharyngeal cancer, liver cancer and colorectal cancer), cardiovascular diseases (e.g. stroke, aortic aneurysm, atherosclerosis and peripheral vascular disease) and various respiratory diseases (e.g. pneumonia, tuberculosis and other chronic respiratory effects). Smoking causes chronic eye and dental diseases (e.g. age-related macular degeneration and periodontitis), impaired immune functions and reproductive functions, rheumatoid arthritis and type-2 diabetes (U.S. Department of Health and Human Services, 2014). Beyond established causes of smoking-attributable deaths, it has been found that there are additional diseases, such as renal failure, hypertensive heart disease, breast cancer and prostate cancer, that account for approximately 17% of excess mortality among current smokers (Carter et al., 2015).

The increased risks of smoking-related mortality and morbidity are due to over 5000 chemicals, including hundreds of different hazardous compounds (Talhout et al., 2011) and at least 69 human carcinogens (such as tobacco-specific nitrosamines, polyaromatic hydrocarbons and volatile organic compounds) that are either in tobacco in itself or are formed by the combustion of tobacco products (NTP, 2011). Consequently, exposure to other people's tobacco smoke, which involves the inhalation of a mixture of the sidestream smoke from the burning cigarette and the mainstream smoke from what smokers exhale, represents a serious health risk and it kills approximately 600,000 people around the world each year (Eriksen et al., 2012). Exposure to secondhand smoke is associated with coronary heart disease, lung cancer and stroke in adults (U.S. Department of Health and Human Services, 2006, U.S. Department of Health and Human Services, 2014), and various respiratory symptoms, impaired lung function, lower respiratory infections and middle ear disease in children (U.S. Department of Health and Human Services, 2006, Royal College of Physicians, 2010). Both active and passive smoking are particularly dangerous during pregnancy, and the potential health consequences are discussed separately in Chapter 1.5.3.

Population-based data from different countries consistently show that smoking prevalence is significantly higher in people with mental disorders than in the general population (Royal College of Physicians and Royal College of Psychiatrists, 2013, Lawrence et al., 2009, Le Cook et al., 2014, McManus et al., 2010). Although there is good evidence to support the comorbidity between tobacco smoking and mental disorders, the underlying mechanisms have not yet been fully understood. Nevertheless, potential explanations have been proposed to fall into three broad categories (Aubin et al., 2012, Royal College of Physicians and Royal College of Psychiatrists, 2013). First, smoking and mental disorders may have common

factors in their aetiology, such as a shared genetic predisposition that has been found in smoking and major depression (Korhonen et al., 2014). Secondly, smoking may be the causal risk factor for the onset of a wide range of mental disorders, such as mood and anxiety disorders (Cuijpers et al., 2007) or Alzheimer's disease (Catalado et al., 2010). Thirdly, the self-medication hypothesis suggests that mental disorders may induce the uptake of smoking due to the pharmacological effects of nicotine that can reduce the negative symptoms of the psychiatric conditions and the side effects of antipsychotic drugs (Kumari and Postma, 2005).

Despite the huge burden of tobacco smoking, stopping smoking can reduce the increased risks of smoking-attributable diseases and premature death (Dresler et al., 2006). For the greatest health benefits, smokers should stop as early as possible, preferably before their mid-thirties when life expectancy starts to drop more steeply, but even smokers who stop much later could gain some benefits in terms of extra life years saved (Doll et al., 2004, Pirie et al., 2013, Sakata et al., 2012, Strandberg et al., 2008). The risk of acute cardiovascular events decreases rapidly after stopping smoking, and most of the elevated risks of cardiovascular diseases disappear within the first five years of abstinence (Dobson et al., 1991, Gellert et al., 2013). Similarly, symptoms of chronic bronchitis improve within months after quitting, and the overall prevalence of the disease declines in ex-smokers close to that of never smokers within five years (Brown et al., 1991). Although it usually requires at least a decade of sustained abstinence when ex-smokers start to have similar risks of smoking-related cancers to that of never smokers (Dresler et al., 2006), smoking cessation substantially lowers the risk of developing smoking-attributable cancers (Dresler et al., 2006, Peto et al., 2000), and it improves the prognosis of cancer patients and survivors (U.S. Department of Health and Human Services, 2014). Furthermore, stopping smoking improves mental health, as ex-

smokers have lower levels of depression, anxiety and stress and a better quality of life than those who do not stop (Taylor et al., 2014).

1.3. Smoking and addiction

Addiction can be defined as "a chronic condition involving a repeated powerful motivation to engage in a rewarding behaviour, acquired as a result of engaging in that behaviour, that has significant potential for unintended harm" (West and Brown, 2013, p.229). The primary reason why millions of people carry on smoking despite the enormous risks is because they are addicted to nicotine (U.S. Department of Health and Human Services, 1988), which generates a potentially very strong motivation to smoke and impairs the individuals' capacity to exercise self-control to inhibit acting on that motivation (West, 2009). Understanding the complex nature of cigarette addiction requires considering the interplay between biological mechanisms and psychological, social and environmental factors (West, 2009, West, 2006b), which are detailed as follows.

Cigarettes have high addictive potential due to a number of factors (U.S. Department of Health and Human Services, 1988, West, 2009). First, they deliver nicotine to the body rapidly, as after a smoker inhales tobacco smoke, nicotine is absorbed into the arterial blood stream through the alveoli of the lungs and it reaches the central nervous system (CNS) within less than 20 seconds by crossing the blood-brain barrier (Benowitz, 1990, Henningfield et al., 1993). Secondly, nicotine alters the function of the CNS by inducing a series of neurobiological mechanisms that primarily, but not exclusively (Watkins et al., 2000), cause abnormalities in the operation of the mesolimbic dopaminergic (DA) system,

also known as the 'reward pathway' (Balfour, 2008). This is because nicotine binds to and stimulates different subtypes of neuronal nicotinic acetylcholine receptors (nAChRs) (e.g. the α4β2 or α6β2 nAChRs) located mainly in the ventral tegmental area (VTA) in the mesencephalon (Colquhoun et al., 2003). Stimulated nAChRs activate mesolimbic DA neurons and increase the N-methyl-D-aspartate receptor induced burst firing of DA neurons; hence, dopamine is released in the nucleus accumbens (NAcc) (Schilström et al., 1998), which generates the impulse to repeat smoking (due to the dopamine release in the NAcc core) and induces pleasant sensations (due to the dopamine release in the NAcc shell) (Balfour, 2004). Thirdly, although nicotine is considered to be the main pharmacologically active compound in tobacco that causes addiction (U.S. Department of Health and Human Services, 1988), it has been suggested that there are other substituents, such as mono-amine oxidase inhibitors, that can also contribute to and enhance the addictive potential of cigarettes by increasing the rewarding effects (Arnold et al., 2014, Lewis et al., 2007). Finally, smoking cigarettes is a highly repetitive activity, as for example a smoker who smokes 10 cigarettes per day repeats the puffing behaviour approximately 140 times each day (Shahab et al., 2008), which provides a strong basis for the learning processes and habit formation involved in the development of addiction.

The most fundamental learning mechanisms that play important roles in addiction are associative learning processes (West and Brown, 2013), such as classical (Pavlov, 1927) and operant conditioning (Skinner, 1953). In operant conditioning, the link between the act of smoking and its rewarding effects is strengthened by positive and negative reinforcements (Watkins et al., 2000). The physiological and psychological underpinnings of these mechanisms involve that the nicotine induced dopamine overflow in the NAcc shell is

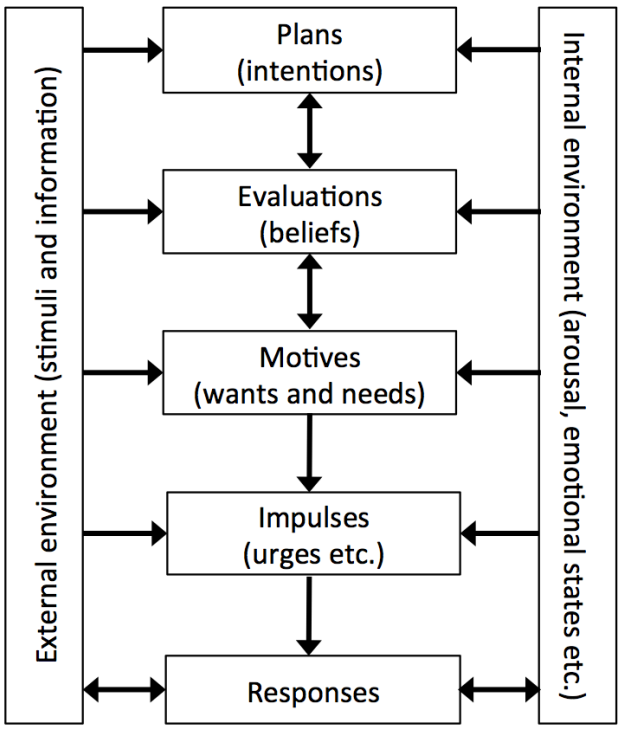
experienced as pleasure and satisfaction (Balfour, 2004), whereby smoking becomes a source of reward, and enjoyment of smoking provides a strong drive to repeat the behavioural pattern (positive reinforcement) (West, 2009). However, repeated exposure to nicotine leads to neuroadaptation in the brain circuits involved (Watkins et al., 2000) and to the appearance of 'nicotine hunger', which creates an acquired drive to smoke when the nicotine concentrations in the CNS are depleted (West, 2009). Additionally, unpleasant withdrawal symptoms occur even after a short period of abstinence, such as urges to smoke, anxiety, irritability, depressed mood, restlessness and difficulty concentrating (Hughes, 2007), and given that these symptoms can be alleviated by smoking, this will drive the behaviour in order to avoid or relieve the symptoms (negative reinforcement) (Watkins et al., 2000).

In the context of classical conditioning, strong links are established between the reinforcing effects of smoking and intrapersonal and extrapersonal stimuli. The act of smoking can be preceded by particular biological effects (e.g. decreased level of nicotine in the body), psychological and emotional states (e.g. stress or negative mood), environmental factors (e.g. the sight of a cigarette or being in a particular situation) and social influences (e.g. peer smoking), all of which can become important cues for the behaviour and induce urges to smoke (Benowitz, 2008). The proposed underlying neurobiological mechanisms are that dopamine overflow in the NAcc core plays a primary role in the automatic learning process of stimulus-response associations and the regulation of goal-directed behaviour in the presence of smoking cues (Balfour, 2004). In this case, the need to smoke does not require the individual to anticipate pleasure, satisfaction or relief from performing the behaviour (West, 2009).

The mechanisms discussed above are of fundamental importance in addiction, and in order to consider these together with further assumptions from existing theories of addiction, the PRIME theory of motivation provides an integrative framework (West and Brown, 2013, West, 2006b). It suggests a comprehensive theory to understand the complexity of addiction on the basis of the human motivational system. A hierarchically structured motivational system of 'Responses', 'Impulses/Inhibitions', 'Motives', 'Evaluations' and 'Plans' has been proposed that evolved so that different subsystems operate with different levels of complexity and flexibility to energise and direct behaviour on a moment-to-moment basis. Higher levels of the motivational system can generate behaviour through lower levels, as shown in Figure 1, and any of the subsystems can function abnormally and can be involved in addiction. This thesis uses PRIME theory as one of its theoretical frameworks and considers cigarette addiction according to the premises of this theory.

On the simplest level of motivation, 'responses' (e.g. smoking a cigarette) are generated by external or internal stimuli to manifest as simple reflexes (West and Brown, 2013, West, 2006b). Responses are also directly influenced by the strongest competing impulses and inhibitions to start, stop or modify actions. 'Impulses and inhibitions' represent the second level of motivation, and although these operate by automatic processes, they have more flexibility of responding to provide a final channel for conscious mental processes to influence behaviour. In addition to external stimuli, impulses and inhibitions arise from emotional states, drives and the most powerful motives at any moment. If the underlying motivational drive cannot be immediately reduced by a relevant action, these motivational forces are experienced as urges (e.g. an urge to smoke in the presence of smoking cues).

Figure 1: The structure of the human motivational system according to the PRIME theory (West and Brown, 2013, West, 2006b)



Starting with the subsystem of 'motives' on the third level, goal-directed behaviour is introduced into the motivational system, as the complexity and flexibility of motives permit future consequences to be taken into account (West and Brown, 2013, West, 2006b). Inputs for motives come from intrapersonal and extrapersonal stimuli, such as drives and emotional states, and also from evaluations, including the recollection of past experiences. Motives are experienced as 'wants' (feelings of anticipated pleasure or satisfaction) and 'needs' (feelings of anticipated relief) (e.g. the want or need to smoke a cigarette), and the strongest from competing motives at any moment can generate behaviour through influencing impulses and inhibitions.

The human specific subsystems of 'evaluations' and 'plans' operate with the highest levels of flexibility and complexity; nevertheless, in order to influence behaviour, they need to be translated into strong enough wants and needs (West and Brown, 2013, West, 2006b). 'Evaluations' are results of conscious mental processes, including people's mental representations about the world ('beliefs'), such as what is good or bad, right or wrong, and useful or detrimental (e.g. a belief that smoking eliminates stress), and mental representations about oneself, such as thoughts, images and feelings about oneself as one is at present or aspires to become in the future (e.g. 'I will be a non-smoker'). The latter constitutes the individual's 'identity'. At the highest level of the motivational system, 'plans' represent mental representations of possible sets of action and self-conscious intentions for a goal-directed behaviour to be achieved (e.g. a plan to stop smoking). Plans can influence behaviour the extent to which they generate motives and are recalled at relevant moments.

1.4. Smoking cessation treatment approaches

Following the announcement of the UK White Paper (policy statement) on Tobacco (Department of Health, 1998), a national network of specialised stop smoking services was established within the English National Health Service (NHS) as a world first in 1999 to provide evidence-based smoking cessation behavioural support and pharmacotherapy for every smoker in England (McNeill et al., 2005). Each year, approximately 600,000 people set a quit date through stop smoking services, and depending on their choice of treatment, they have access to one-to-one and group behavioural support, telephone support, nicotine replacement therapy (NRT), varenicline and bupropion for free, or for a small fee, at the point of access (Health and Social Care Information Centre, 2014). Even though there is

considerable variation between different stop smoking services in the proportion of people who achieve four-week carbon monoxide (CO)-verified abstinence (Health and Social Care Information Centre, 2014), and only a small proportion – approximately 15% – remains abstinent at one year (Ferguson et al., 2005), treating cigarette addiction in the population is an effective and the most cost-effective life-preserving method to improve public health and to reduce health inequalities (West et al., 2013, APPG, 2010, West and Stapleton, 2008, Bauld et al., 2010).

The overarching aim of different smoking cessation treatment approaches is to help smokers maintain their motivation not to smoke higher than the motivation to smoke at any moment when the opportunity for smoking presents itself (West and Brown, 2013). The effectiveness of individual cessation aids, including NRT, face-to-face or telephone behavioural support, bupropion and varenicline, to increase abstinence at six months varies from 5 to 15% (West and Stapleton, 2008) compared with unaided quitting with its 3 to 5% success rates (Hughes et al., 2004). Even though there is ample evidence both from clinical trials (Stead and Lancaster, 2012) and 'real-world' population studies (Kotz et al., 2013b, Kotz et al., 2014) that the most effective smoking cessation treatments are those that combine pharmacotherapy with specialist behavioural support (yielding 15 to 20% success rates), only a minority of smokers – approximately 2% – engage with the combination of these treatments in England. Moreover, almost 50% of smokers who attempt to quit in a given year, try to do so completely unaided (Raupach et al., 2013).

1.4.1. Pharmacological support

Medications that are licenced as first-line treatments for smoking cessation in the general population in the UK include NRT, varenicline and bupropion, all of which are available on prescription (MHRA, 2014). In addition, different types of NRT (i.e. nicotine chewing gum, transdermal nicotine patch, nicotine nasal spray and mouth spray, nicotine lozenge and sublingual tablets) can also be bought over the counter (MHRA, 2014).

NRT delivers pure nicotine to the body that enters the bloodstream via the buccal or nasal mucosa, or through the skin. It helps smokers reduce their motivation to smoke by reducing the urges to smoke and eliminating the effects of nicotine withdrawal (Stead et al., 2012). Randomised controlled trials (RCTs) have found that regardless of the mode of delivery of nicotine, NRT is effective to increase the chance of quit success compared with placebo or no treatment (Stead et al., 2012). However, recent population-based studies have shown that the 'real-word' effectiveness of NRT bought over the counter do not differ (Kotz et al., 2013b) or it is significantly lower than that of unaided quitting (Kotz et al., 2014), which might be due to inadequate use of NRT. Nevertheless, there is strong evidence to suggest that the combination of two or more forms of NRT (e.g. nicotine patch with a faster acting form, such as nicotine spray) is more effective than a single form NRT (Brose et al., 2011, Kotz et al., 2013b, Kotz et al., 2014, Stead et al., 2012, Cahill et al., 2013).

Smoking cessation medications on prescription (e.g. varenicline, bupropion and cytisine) do not deliver nicotine to the body; instead, they act on the same neuronal structures that are affected by nicotine. Varenicline (marketed as Champix or Chantix) is a selective nAChRs

partial agonist; thus, it maintains a moderate activation of the mesolimbic DA neurons and induces a constant release of dopamine in the NAcc, whereby it reduces the rewarding effects of smoking and decreases cravings and withdrawal (Cahill et al., 2012). Both in terms of efficacy and 'real-world' effectiveness, varenicline has been found to be as effective (Cahill et al., 2013) or slightly more effective than combination NRT (Brose et al., 2013b), and more effective than single form NRT (Cahill et al., 2013, Hsueh et al., 2014) or bupropion (Cahill et al., 2013, Cahill et al., 2012).

Bupropion (marketed as Zyban) was originally developed as an atypical antidepressant, but it is also widely used to aid cessation (Hughes et al., 2007). It alters the levels of different neurotransmitters in the brain, such as dopamine and acetylcholine, but the primary mechanism through which it is considered to exert its effects to relieve withdrawal symptoms and to reduce the severity of cravings is the inhibition of dopamine reuptake in the NAcc. Clinical trials have consistently found that bupropion is more effective than placebo to increase quit success, but it is somewhat less effective than varenicline (Cahill et al., 2013, Hughes et al., 2007).

Compared with varenicline or bupropion, cytisine (marketed as Tabex) is an inexpensive form of non-nicotine smoking cessation medication. It is a partial nAChRs agonist, and it has been shown to be effective to increase smokers' chance of quitting (Cahill et al., 2013, Hajek et al., 2013). Although it is yet to be licenced for smoking cessation in the UK, cytisine is commonly used in countries like Russia, Poland and Bulgaria (Cahill et al., 2013, Hajek et al., 2013).

1.4.2. Behavioural support

Behavioural approaches to cessation use specific behaviour change techniques (BCTs) (West et al., 2010) to help smokers reduce their motivation to smoke, increase their motivation not to smoke, maximise their self-regulatory capacity and get the most out of adjunctive behaviours, such as using stop-smoking medicines, and in that way increase smokers' ability to remain smoke free (West, 2009). Behavioural support varies in the intensity of the intervention, ranging from brief advice to multi-session programmes, and the mode of delivery, such as face-to-face or telephone support and self-help materials (West et al., 2000). Overall, there is good evidence to suggest that all main types of behavioural support are effective to increase the chance of successful quitting in the general population (Stead et al., 2013a, Stead et al., 2013b, Lancaster and Stead, 2005, Stead and Lancaster, 2005).

Face-to-face support can be provided for smokers individually or in small groups. Most commonly in England, smokers receive one-to-one counselling at specialist stop smoking services, primary care and pharmacies (Department of Health, 2012). Both multi-session counselling and brief advice have been found to increase quit rates (Lancaster and Stead, 2005), but intensive forms of individual behavioural support, such as providing a series of weekly one-to-one counselling with a trained stop smoking advisor before and after quitting (Department of Health, 2012), can be more effective than less intensive interventions (Stead et al., 2013a, Bauld et al., 2010). Nevertheless, even a brief smoking cessation advice from a health professional could improve cessation rates compared with usual care or no advice (Stead et al., 2013a).

Group support programmes are led by stop smoking advisors, and they generally involve weekly counselling sessions for at least four weeks following the individuals' quit date (NICE, 2008). Engaging with these interventions can provide smokers the additional benefit of receiving peer support, as they can share their experiences with each other, learn from each other and support each other as they are going through the process of quitting smoking (Stead and Lancaster, 2005). Previous studies have shown that group support is an effective smoking cessation aid (Stead and Lancaster, 2005), and there is some evidence to show that it can be more effective than individual counselling (Brose et al., 2011, Bauld et al., 2010).

There are many countries in the world, including England, where smokers can call specialised quitlines to receive instant help and advice from a stop smoking advisor (reactive telephone support), and they can also receive one or more calls from advisors at pre-arranged times as part of a smoking cessation programme (proactive telephone support) (U.S. Department of Health and Human Services, 2008). Both approaches can increase smokers' chance of quitting, and they can be particularly useful to provide a route for smokers to get access to more intensive forms of support (Stead et al., 2013b). Moreover, proactive telephone support involving at least three or more calls appears to increase quit rates compared with a single call counselling, self-help materials, brief advice or pharmacotherapy alone (Stead et al., 2013b).

Traditionally, printed and/or electronic materials, such as leaflets, books and DVDs, are used as self-help materials to deliver behavioural support without the need to contact health professionals or as an adjunct to face-to-face support or pharmacotherapy. Although self-help interventions represent less intensive forms of behavioural support, they have the potential

for a wide reach (Lancaster and Stead, 2009, Hartmann-Boyce et al., 2014). According to a recently updated Cochrane systematic review of self-help interventions (Hartmann-Boyce et al., 2014), printed materials are effective to improve cessation rates compared with no intervention, and tailored self-help materials can be more effective than non-tailored ones. However, the absolute size of effect of self-help appears to be small and just reaches statistical significance. Moreover, it has been found that there is no incremental benefit of adding self-help interventions to brief behavioural support in order to increase people's chance of quitting in the general population (Lancaster and Stead, 2009, Hartmann-Boyce et al., 2014).

1.4.3. Digital smoking cessation interventions

Globally, there are approximately seven billion mobile subscriptions and three billion internet users representing 96% and 40% of the world's population, respectively (International Telecommunication Union, 2014). In the UK alone, 87% of the population have access to internet (Office for National Statistics, 2014a), 92% own a personal mobile phone (Ofcom, 2011), and 75% own a smart mobile device (i.e. smartphones and tablets) (Deloitte, 2013). In a representative sample of adult smokers in England, 70% reported having at least weekly access to internet and 42% reported accessing handheld computers (Brown et al., 2013). The widespread penetration of the internet and interactive mobile technologies, and a great extent to which these technologies are integrated into people's life provide an opportunity to use them as novel ways of delivering smoking cessation support on a population level (Civljak et al., 2013).

However, the terminology that ought to be used when referring to such interventions is yet to be established. Consequently, these interventions are commonly described by broader umbrella terms (e.g. eHealth or mHealth interventions), the hardware delivering the intervention (e.g. computer-based or mobile phone-based interventions), or the specific network or software through which the intervention content is distributed (e.g. internet-/web-based, text-messages based or app-based interventions). Due to a lack of consensus in this field, this thesis uses the term 'digital behaviour change interventions' to refer to interventions that are specifically designed to be available on digital platforms, including fixed and/or portable digital devices that have a set of capabilities to permit the delivery of intervention content through different networks, such as online, offline and text-messaging services, and via specific software, such as smartphone applications (apps).

The advantages of digital smoking cessation interventions include that they can be delivered on a relatively low cost per user (exploit economies of scale) (Guerriero et al., 2013), they can reach smokers who want to quit smoking but do not seek professional support (BinDhim et al., 2014), and they can be accessed any time and are available anywhere through portable devices, including demographic areas with limited access to stop smoking services. Moreover, digital aids provide complete anonymity for the user, ready access to potentially personalized support, distraction through built-in interactive functions, and the opportunity to receive behaviour change messages more frequently and immediately on demand (Civljak et al., 2013, Whittaker et al., 2012). On the other hand, support from 'real-world' experts and peers might be missing (Ghorai et al., 2014), the intervention content might not correspond to established treatment guidelines (Civljak et al., 2013, Abroms et al., 2013), and the attrition rates can be particularly high in digital interventions, as participants usually stop using the

programmes before the intervention finishes (Ghorai et al., 2014, Eysenbach, 2005).

RCTs and quasi-RCTs of different types of digital smoking cessation interventions have been the subjects of numerous systematic reviews and meta-analyses in recent years. Depending on a particular review, included studies evaluated the effectiveness of interventions that primarily utilised websites (Shahab and McEwen, 2009, Civljak et al., 2013, Hutton et al., 2011), websites or computer-based programmes (Myung et al., 2009), mobile phones (Whittaker et al., 2012) and websites, computer-based programmes, mobile phones or other electronic aids (Chen et al., 2012). Two of the main conclusions that have arisen from these works are that regardless of the specific mode of delivery, digital interventions can be effective to aid cessation in the general adult population, but this needs to be considered alongside a considerable heterogeneity in quality, outcomes, and design that have also been found in the reviewed studies.

In terms of specific types of digital smoking cessation aids, text-messaging interventions can improve long-term quit outcomes compared with minimal treatment (Whittaker et al., 2012). It has been found that smokers who engage with a purely text-messaging intervention, such as the 'txt2stop' programme in the UK that provides individually tailored automated cessation support before and after individuals' quit date, have more than twice the chance of quit success than those who do not receive cessation support (9% and 4% biochemically-verified continuous abstinence rates at six months, respectively) (Free et al., 2011). Although interventions using the simplest but most widely available technological function of text-messaging offer relatively limited potential for interactivity, additional motivational messages, relapse prevention tips and advice to help overcome cravings are commonly sent

on demand (Devris et al., 2013, Snuggs et al., 2012, Free et al., 2011, Abroms et al., 2014). Moreover, text-messaging interventions can be provided in conjunction with more interactive forms of automated support, such as personalized websites (Whittaker et al., 2012, Abroms et al., 2014), or face-to-face cessation support in clinical practice that may increase long-term abstinence compared with usual care (Naughton et al., 2014).

Smoking cessation websites can increase long-term abstinence compared with usual care or self-help materials (Myung et al., 2009, Hutton et al., 2011, Shahab and McEwen, 2009, Civljak et al., 2013), and interactive tailored websites might be more effective than non-tailored interventions (Shahab and McEwen, 2009, Civljak et al., 2013). However, the results are inconclusive regarding the relative benefit of personalized websites, as they may increase quit rates compared with usual care or printed self-help materials, but not non-tailored websites (Civljak et al., 2013). Nevertheless, an interactive website delivering individually tailored evidence-based cessation support in the UK ('StopAdvisor') has been found to achieve significantly higher biochemically-verified continuous abstinence rates at six months than a non-tailored static website among smokers with low socioeconomic status (8% vs. 6% in StopAdvisor and control website, respectively) (Brown et al., 2014). The relative benefit of StopAdvisor was not detected in smokers with high socioeconomic status and in the overall sample (Brown et al., 2014). Further details of StopAdvisor are discussed in Chapter 9, as this thesis uses a minimally tailored pregnancy version of the website to inform the intervention development.

Apps represent more advanced technology than text-messages and websites, as these self-contained mobile programmes can take full advantages of the multi-touch interface and all

other functionalities of smart digital devices, such as smartphones, tablets and smartwatches, for which apps are specifically developed. People can download apps from dedicated web-based stores, such as the Apple App Store (https://itunes.apple.com) and Google Play (https://play.google.com), and once installed, apps can potentially be used both online and offline. Currently, hundreds of smoking cessation apps are available in these stores, but only a few appear to adhere to established guidelines of smoking cessation treatments (Abroms et al., 2011, Abroms et al., 2013, Bennett et al., 2014), and little evidence has been published on the effectiveness of smartphone apps to aid cessation.

More recently, two pilot studies have indicated that theory-driven evidence-based apps might generate significant public health benefits by improving quit outcomes (Bricker et al., 2014, Ubhi et al., 2015). The SmartQuit app (www.2morrowinc.com) uses the Acceptance and Commitment Therapy to encourage smokers to become aware of their urges to smoke and learn how to think about those urges without acting on them (Bricker et al., 2014). It has been found that SmartQuit users had higher self-reported quit rates at two months than those who received a control app delivering cessation support based on the United States national smoking cessation website (www.smokefree.gov); however, the difference was not statistically significant (13% in SmartQuit vs. 8% in control, respectively) (Bricker et al., 2014). The SmokeFree28 app (SF28) (www.sf28.co.uk) has been developed on the basis of PRIME theory (details of the theory are discussed in Chapters 1.3., 2.2.1. and 2.2.2.) and evidence-based BCTs to help smokers maintain their motivation and self-regulatory capacity to overcome impulses to smoke and remain abstinent for at least 28 days (Ubhi et al., 2015). It has been reported that 18.9% of smokers who engaged with the app reported having been abstinent for 28 days or longer (with no more than two lapses) (Ubhi et al., 2015), which is

higher than the success rate that would be expected from unaided quitting – approximately 15% – based on population estimates in England (Kotz et al., 2013b).

1.5. Smoking in pregnancy

1.5.1. Smoking prevalence in pregnancy

The extent to which national figures of smoking and smoking cessation in pregnancy are monitored and documented differs markedly across countries, and commonly, data are not readily available. Nevertheless, population estimates show large variations in the prevalence of smoking during pregnancy between countries that can be, at least partly, explained by cultural differences, constraints on women's smoking (Nichter et al., 2010) and the different stages of the tobacco epidemic (Lopez et al., 1994). The proportion of pregnant women who smoke can be particularly high in some low and middle income countries (Caleyachetty et al., 2014), such as Serbia (37.2%) (Krstev et al., 2012), and it varies relatively widely across high-income Western countries (Smedberg et al., 2014). For example, the prevalence of smoking during pregnancy ranges from 5% in Iceland (Erlingsdottir et al., 2014) to 11-13% in Canada (10.5%) (Al-Sahab et al., 2010), the United States (12.3%) (Tong et al., 2013), Norway (12.9%) (Hauge et al., 2012), and Australia (13.2%) (Li et al., 2013).

In England, the most recent data from the Infant Feeding Survey (IFS) (McAndrew et al., 2012) showed that 26% of women smoked at some point in the 12 months immediately before or during pregnancy, and 12% smoked throughout pregnancy in 2010. Although a decrease in overall prevalence has been recorded since the previous IFS in 2005 (Bolling et

al., 2007), the pattern of results has remained the same. In 2010, the prevalence of smoking throughout pregnancy was disproportionately high in the youngest age groups: women aged under 20 (35%) and 20 to 24 (22%), and the proportion of women who smoked throughout pregnancy was five times higher in low socioeconomic groups than high socioeconomic groups (20% and 4%, respectively). To supplement the quinquennial IFS, data on women's smoking status at time of delivery (SATOD) are also routinely collected to monitor prevalence at a local level in England (HSCIC, 2014). According to SATOD, the overall prevalence of smoking during pregnancy has decreased from 15.1% in 2006/07 to 12% in 2013/14, but it also shows that there are considerable regional variations within the country (HSCIC, 2014).

Smoking prevalence is calculated based on self-report both in the IFS (McAndrew et al., 2012, Bolling et al., 2007) and in SATOD (HSCIC, 2014), which is considered as a less reliable method for assessing the smoking status of pregnant smokers than by measuring expired-air CO or saliva cotinine (Benowitz et al., 2002). This is because pregnant smokers might conceal their smoking status (Bauld and Coleman, 2009), especially young women (Dietz et al., 2011) and those from high socioeconomic groups (Shipton et al., 2009). Although the National Institute for Health and Care Excellence (NICE) public health guidance in England recommends midwives to monitor women's CO level at maternity appointments (NICE, 2010), SATOD is based on self-report (HSCIC, 2014) and local trusts have been found to vary in the completeness and reliability of the data that they collect (Dhalwani et al., 2013). Therefore, it cannot be ruled out that the prevalence of smoking during pregnancy derived from both sources might be underestimated (ASH, 2013).

1.5.2. Factors associated with smoking in pregnancy

Being addicted to nicotine is one of the main factors contributing to smoking during pregnancy. Pregnant smokers have been found to smoke more heavily prior to and during pregnancy than those women who quit at some point during pregnancy (Alves et al., 2013, Scott et al., 2009, Gyllstrom et al., 2012, Schneider et al., 2010, Erlingsdottir et al., 2014). Additionally, socio-demographic, psychological, and environmental factors could also play important roles in pregnant women's smoking behaviour, which are detailed as follows.

The associations between women's socio-demographic and maternity characteristics and smoking status during pregnancy are well documented. There is strong evidence to support that low educational attainment is significantly associated with smoking during pregnancy (Erlingsdottir et al., 2014, Alves et al., 2013, Orton et al., 2014, Tong et al., 2013, Baron et al., 2013, Al-Sahab et al., 2010, Gyllstrom et al., 2012, Smedberg et al., 2014). Similarly, young women (Hoekzema et al., 2014, Orton et al., 2014, Smedberg et al., 2014), those who have their first child at a young age (Al-Sahab et al., 2010), and who are from low socioeconomic groups (Orton et al., 2014, Hoekzema et al., 2014, Gyllstrom et al., 2012) are more likely to smoke in pregnancy. Additionally, there is evidence to suggest that being multigravida (Mohsin and Bauman, 2005) or having an unplanned pregnancy are associated with smoking during pregnancy (Smedberg et al., 2014, Schneider et al., 2010).

Pregnant smokers' psychological characteristics can be of fundamental importance in smoking during pregnancy. Women who have low self-confidence in their ability to stop smoking are less likely to quit when expecting a baby (Maxson et al., 2012, Woodby et al.,

1999). Similarly, pregnant women who have mental disorders (Royal College of Physicians and Royal College of Psychiatrists, 2013), high levels of anxiety, depressed mood (Hauge et al., 2012, Baron et al., 2013, Scott et al., 2009), or daily stress due to permanent problems (e.g. relationship problems or financial difficulties) are more likely to smoke throughout pregnancy (Gyllstrom et al., 2012, Hauge et al., 2012, Al-Sahab et al., 2010). A previous meta-ethnography reported that women who continue to smoke during pregnancy may establish a firm smoker identity prior to pregnancy, and from their perspective, smoking can represent an important source of enjoyment and it can serve as a coping strategy to manage difficult life circumstances (Flemming et al., 2013). If smoking is perceived as a deeply entrenched part of life, even if women try to quit in order to reduce feelings of guilt and avoid the social stigma associated with being a pregnant smoker, cessation may be considered as a temporary behaviour change, which is done only for the sake of the baby (Flemming et al., 2013).

In terms of the social environment, previous studies have found that pregnant smokers who are single are less likely to quit compared with those who are married or have a partner (Hauge et al., 2012, Al-Sahab et al., 2010, Hoekzema et al., 2014, Baron et al., 2013, Smedberg et al., 2014). However, living with a smoker partner, other family members who smoke, and having smoker friends have been repeatedly identified as significant barriers to stopping smoking during pregnancy (Hoekzema et al., 2014, Schneider et al., 2010).

1.5.3. Health consequences of smoking and benefits of cessation in pregnancy

Over and above all the health consequences of smoking, as detailed in Chapter 1.2., smoking

during pregnancy carries additional health risks. Prenatal exposure to maternal tobacco smoke is detrimental to fetal development and it causes a range of diseases and health conditions during pregnancy (Ross et al., 2015, U.S. Department of Health and Human Services, 2014). Maternal smoking is the leading avoidable cause of spontaneous abortion and neonatal mortality and morbidity in industrialised countries (Royal College of Physicians, 2010), which places a large financial burden on public health care systems (Godfrey et al., 2010).

Tobacco compounds that are absorbed into the maternal bloodstream (e.g. nicotine, CO and various carcinogens) can reach the fetus directly through the umbilical cord and indirectly from the amniotic fluid through gastrointestinal and skin absorption (Ross et al., 2015). As a result, the concentrations of these substances are approximately 15% higher in the fetus than in the mother (Longo, 1977, Koren, 1995). In addition, tobacco compounds in the placenta induce irreversible changes in its structural and functional development (Zdravkovic et al., 2005), and they decrease the oxygen and nutrients supply of the fetus by causing vasoconstriction and hypoxia in the blood vessels of the uterus (Lambers and Clark, 1996). Prenatal exposure to nicotine disrupts fetal brain development, as it stimulates nAChRs and alters the functioning of the cholinergic system in its earliest stages of development, which can contribute to long-term neurobehavioural impairments (Ross et al., 2015, U.S. Department of Health and Human Services, 2014). Overall, evidence suggests that there is a dose-response relationship between prenatal tobacco exposure and adverse health effects, particularly in relation to the risks of miscarriage, fetal growth restriction and low birth weight (Pineles et al., 2014, Lambers and Clark, 1996, Yan and Groothuis, 2015, Windsor et al., 1999, Hebel et al., 1988). A steep decline in birth weight occurs even at low levels of

tobacco exposure (e.g. more than five cigarettes per day) (Hebel et al., 1988).

Smoking during pregnancy has been causally linked with pregnancy complications, such as premature rupture of the membrane, placenta previa, placental abruption and preterm delivery (earlier than 37 weeks) (U.S. Department of Health and Human Services, 2004). Furthermore, it causes fetal growth restriction, very low and low birth weight (less than 1500g and less than 2500g, respectively), sudden infant death syndrome, postnatal reduced lung function, lower respiratory infections and middle ear disease (U.S. Department of Health and Human Services, 2004). The 2014 Surgeon General's report concludes that there is sufficient evidence to suggest that maternal smoking causes ectopic pregnancy, a potentially fatal condition both for the pregnant woman and her fetus, and orofacial clefts and various congenital defects for the baby (U.S. Department of Health and Human Services, 2014).

Consequences of prenatal exposure to maternal smoking can occur throughout the life of the child. There are well-documented associations between smoking during pregnancy and increased risks of overweight (Oken et al., 2008, Wang et al., 2013), impaired language skills (Ross et al., 2015), attention deficit problems, including more severe forms of attention deficit hyperactivity disorder (ADHD), behaviour problems and learning difficulties in children (Cornelius et al., 2012, Batstra et al., 2003, Gaysina et al., 2013, Ross et al., 2015, Thakur et al., 2013); poor academic achievement and cognitive deficit (Ross et al., 2015), antisocial behaviour and ADHD in teenagers and young adults (Button et al., 2005, Ross et al., 2015); and nicotine dependence in adults (Buka et al., 2003, O'Callaghan et al., 2009).

Postnatal exposure to secondhand tobacco smoke is also harmful for children, and it increases

the risks of sudden infant death syndrome (U.S. Department of Health and Human Services, 2006), various respiratory diseases (Burke et al., 2012, Jones et al., 2011) and middle ear infections (Jones et al., 2012, U.S. Department of Health and Human Services, 2006). In the long-term, children who are exposed to other people's tobacco smoke are more likely to take up smoking (Leonardi-Bee et al., 2011). Although many countries have now implemented legislative smoking bans that led to a reduction in secondhand smoking worldwide (Callinan et al., 2010), approximately 40% of children across the world, especially those with low socioeconomic status (Moore et al., 2011), are still passive smokers (Eriksen et al., 2012).

Stopping smoking during pregnancy is one of the most important things that women can do to avoid pregnancy complications and protect their children's health. Research shows that ex-smoker women, who quit smoking before conception or within the first 12 weeks of pregnancy, have similar risks of preterm birth, premature rupture of the membrane, fetal growth restriction and low birth weight to that of non-smoker pregnant women (Vardavas et al., 2010, Bickerstaff et al., 2012, Batech et al., 2013, Hodyl et al., 2014, Yan and Groothuis, 2015). Although the sooner they stop smoking the better, even if pregnant women quit before the third trimester, they can still gain some benefits in terms of the increased birth weight of the baby (Yan and Groothuis, 2015). Of all pregnancy specific adverse health conditions, the one that is known to be worsened by stopping smoking is preeclampsia, as women who do not smoke at all or quit before the third trimester have higher risks of developing this condition than pregnant smokers (Engel et al., 2013, Hodyl et al., 2014). In this case, the protective role of smoking appears to be mediated by the biological effects of CO in combustible tobacco products (Karumanchi and Levine, 2010).

Only a few studies have reported evidence of the potential benefits of smoking reduction in pregnant smokers who cannot stop completely. In relation to improved birth weight of the baby, it has been suggested that in order to benefit from smoking reduction, women need to cut down to five or fewer cigarettes per day (Hebel et al., 1988). Studies assessing the effects of a significant – 50% or greater – smoking reduction by the third trimester have found that the mean birth weight of infants was 92g heavier in pregnant smokers with cotinine-verified smoking reduction compared with women who did not cut down (Windsor et al., 1999). However, the mothers' baseline smoking level is critically important in terms of the effects of a 50% smoking reduction. It has been shown that only those who initially did not smoke more than five cigarettes per day before they cut down by 50% had babies with higher birth weight (by a mean of 201g) compared with persistent light smokers (England et al., 2001). More recently, findings from a large birth cohort in the UK have also shown that smoking reduction during pregnancy significantly improved the birth weight of infants of initially heavy smokers (Yan and Groothuis, 2015). The timing of smoking reduction may also be important, as women who cut down to fewer than 10 cigarettes per day before the second trimester have newborns of the same weight as newborns of persistent light smokers (Yan and Groothuis, 2015). Nevertheless, studies have consistently found that the greatest health benefits in terms of improved birth outcomes can be achieved by complete smoking cessation (Benjamin-Gardner and Stotts, 2013, Yan and Groothuis, 2015, Windsor et al., 1999, Hebel et al., 1988, England et al., 2001).

1.5.4. Smoking cessation interventions in pregnancy

Reducing smoking rates among pregnant women is an important public health priority and it

is one of the three national ambitions in the Tobacco Control Plan for England that has set a target of reducing the prevalence of smoking throughout pregnancy nationally to 11% or below (at time of delivery) by the end of 2015 (Department of Health, 2011). In line with the aforementioned goal, the NICE guidance recommends that all pregnant women in England should be asked about their smoking status by health care providers (HCPs), such as midwives, general practitioners, obstetricians and gynecologists, and CO monitoring should be utilized in routine practice (NICE, 2010).

It is suggested that all pregnant smokers should be provided with brief advice about stopping smoking and referred to a local stop smoking service (NICE, 2010). Referral can be made either via an opt-in referral route, when pregnant smokers are provided the opportunity to be referred if they wanted to, or via opt-out referrals, when each pregnant smoker is referred to a local stop smoking service unless one actively declines it (Fahy et al., 2014). Intensive behavioural support with pharmacotherapy is available for free and at various locations, including pregnant women's home, stop smoking services, maternity units or via telephone (Fahy et al., 2014, NICE, 2010). Each year approximately 20,000 pregnant smokers set a quit date within stop smoking services, but this number has begun to decline in the past two years (Health and Social Care Information Centre, 2014).

As opposed to the general population, neither bupropion nor varenicline is prescribed in pregnancy, but single form and combination NRT are recommended as pharmacological support for pregnant smokers in England (NICE, 2010). Although using pure nicotine is likely to be less harmful than smoking cigarettes (Ruiz, 2006) and the nicotine level is substantially lower in people who are using NRT than in active smokers (Lambers and Clark,

1996), a recent Cochrane review concluded that there is still insufficient evidence to determine the efficacy and safety of NRT in pregnant smokers (Coleman et al., 2012a).

However, a number of things need to be considered regarding the efficacy and effectiveness of NRT use in pregnancy. First, poor adherence to NRT is generally reported among pregnant smokers (Coleman et al., 2012b, Oncken et al., 2008). Secondly, it appears that they would potentially need higher doses of NRT to obtain the same effect as people in the general population due to faster nicotine metabolism in pregnancy (Dempsey et al., 2002, Bowker et al., 2014). In line with this, it has been reported in a study of pregnant women receiving support from stop smoking services that combination NRT is associated with increased CO-verified four-week abstinence rates; whereas, a single form NRT does not appear to confer benefit in terms of improved quit rates (Brose et al., 2013a). Thirdly, a large randomised placebo-controlled trial has recently shown that women who use NRT during pregnancy are more likely to have infants with no developmental impairments at the age of two than women who do not use NRT (Cooper et al., 2014). The observed health benefits might be because pregnant smokers manage to stop smoking for a period of time using NRT (Cooper et al., 2014).

There is good evidence that behavioural interventions for pregnant smokers increase smoking abstinence, but not smoking reduction rates, in late pregnancy and decrease the risks of preterm delivery and low birth weight compared with usual care or no intervention (Chamberlain et al., 2013). In terms of specific types of support, interventions that involve the provision of financial incentives contingent on smoking cessation have been consistently found to increase abstinence rates in pregnancy (Tappin et al., 2015, Higgins et al., 2012,

Bauld and Coleman, 2009, Chamberlain et al., 2013, Mantzari et al., 2012). Similarly, interventions using cognitive and behavioural strategies to increase pregnant smokers' motivation to quit, and improve their problem solving and coping skills are more effective than usual care or no intervention (Chamberlain et al., 2013, Bauld and Coleman, 2009), especially if the support is individually tailored to the needs of pregnant women (Chamberlain et al., 2013). Moreover, evidence suggests that self-help interventions (Bauld and Coleman, 2009, Naughton et al., 2008) and specifically targeted peer support interventions can help pregnant smokers stop smoking (Chamberlain et al., 2013). Providing information about the potential health consequences of smoking for the baby and giving feedback on the specific effects (e.g. CO levels) may improve quit outcomes; however, information about the health risks alone or brief advice without further support do not appear to be effective in pregnant smokers (Chamberlain et al., 2013). Similarly, there is insufficient evidence of the effectiveness of partners' support as part of smoking cessation interventions for pregnant smokers (Chamberlain et al., 2013, Hemsing et al., 2012).

Historically, even if effective face-to-face smoking cessation programmes are available, the uptake is low among pregnant smokers (Tappin et al., 2010, Taylor and Hajek, 2001, Tong et al., 2008). Research shows that pregnant women want to quit smoking and express their interest in receiving smoking cessation support (Ussher et al., 2004), but many find it very difficult (Graham et al., 2011) and face numerous barriers in doing so, including anticipated fear of embarrassment and stigmatization, negative attitude towards the interventions provided by health professionals, poor access to the health care facilities and fear of disappointment if the quit attempt failed (Ingall and Cropley, 2010, Ussher et al., 2006, Herberts and Sykes, 2012, Butterworth et al., 2014).

Given the general characteristics of digital smoking cessation programmes, as detailed in Chapter 1.4.3., they might appeal to pregnant smokers who cannot or do not want to engage with face-to-face support. Previous findings suggest that women and younger people are more likely to use digital aids for cessation (Ubhi et al., 2015, Devris et al., 2013) and they appear to engage with the built-in functions of these programmes, such as the option of requesting lapse and relapse prevention messages (Devris et al., 2013). However, unlike for the general population, only a few digital smoking cessation interventions have been developed specifically for pregnant smokers, and little published evidence is available of their feasibility and effectiveness.

To date, apart from an educational website for childbearing adolescents that provides information about the risks of smoking during pregnancy (Comer and Grassley, 2010), four pregnancy-specific digital smoking cessation interventions have been reported in peer-reviewed journals. Of these, three are text-messaging programmes to aid scheduled gradual smoking reduction (Pollak et al., 2013) or complete cessation ('MiQuit') (Naughton et al., 2012, Abroms et al., 2015), and one is an interactive smoking cessation website to promote complete cessation in pregnancy ('MumsQuit') (Herbec et al., 2014b). Both qualitative (Naughton et al., 2013b, Herbec et al., 2014a, Soklaridis et al., 2014, Abroms et al., 2015) and quantitative studies (Pollak et al., 2013, Herbec et al., 2014b, Naughton et al., 2012, Abroms et al., 2015) have reported that text-messaging programmes and websites could be acceptable, engaging and potentially helpful to pregnant smokers, especially if the intervention delivers sufficiently tailored content, but in terms of effectiveness, studies have not found statistically significant effects of these programmes to increase quit rates.

Although seven-day cotinine-validated point prevalence abstinence at six weeks was higher in pregnant women who were allocated to a gradual smoking reduction text-messages intervention compared with those who received minimal intervention (13.4% and 7.5%, respectively) (Pollak et al., 2013), and seven-day cotinine-validated point prevalence abstinence at three months was higher in the MiQuit text-messaging intervention group compared with those who received printed self-help materials (12.5% and 7.8%, respectively) (Naughton et al., 2012), the difference was not statistically significant. Similarly, a statistically non-significant difference in self-reported continuous four-week abstinence was found between women who were allocated to the MumsQuit website compared with those in a minimal intervention condition (28% and 21%, respectively) (Herbec et al., 2014b).

Overall, studies have shown that digital interventions could be popular among pregnant smokers and might help them stop smoking, but further research is needed to assess the extent to which this approach might be effective to increase smoking cessation rates in pregnancy.

CHAPTER 2 – DEVELOPING BEHAVIOUR CHANGE INTERVENTIONS TO AID SMOKING CESSATION

2.1. Methodological and pragmatic considerations for the development and evaluation of complex interventions

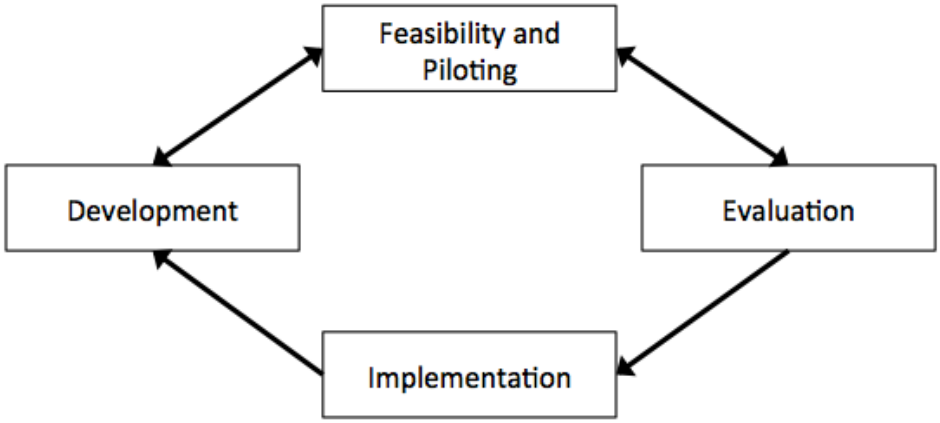
2.1.1. The Medical Research Council's guidance

Generally, behavioural approaches to smoking cessation support can be considered as complex interventions due to the number of interacting components in these programmes, the various strategies used to deliver the cessation support, the non-linear causal pathways through which components can influence outcome and the potentially high degree of flexibility and tailoring that these interventions usually permit (Craig et al., 2008, Petticrew, 2011). Characterising different types of cessation aids as 'simple', such as a pharmacological intervention in which a given medication is considered the main active component that can cause an effect, versus 'complex' interventions, such as a digital smoking cessation intervention in which various interacting components have a potential to influence behaviour, has important practical implications to inform decisions regarding the most appropriate approach to the development and evaluation of a given intervention (Petticrew, 2011).

The UK Medical Research Council's (MRC) guidance (Craig et al., 2008) proposes a four-stage process of developing and evaluating complex interventions, as shown in Figure 2. It starts with the 'development' stage, which is followed by the 'feasibility and piloting', 'evaluation', and 'implementation' stages (Craig et al., 2008). The four stages connect to

each other to form a cycle with feedback loops between the first three stages to indicate the necessarily iterative nature of developing complex interventions (Craig et al., 2008, Campbell et al., 2000).

Figure 2: The process of developing and evaluating complex interventions according to the UK's Medical Research Council's guidance (Craig et al., 2008)



The guidance emphasizes the importance of using both qualitative and quantitative evidence obtained in different stages to inform intervention development and, if needed, the refinement of the intervention and the methodology before moving on to a next stage (Craig et al., 2008). Therefore, in order to successfully develop and evaluate a potentially effective intervention that is likely to be implemented adequately, the MRC guidance suggests that all stages are critically important, and as such each should be given equal emphasis in the process of intervention development (Craig et al., 2008).

In terms of the specific functions of various stages, the MRC guidance recommends that the development stage should begin with identifying the theoretical framework and the best

available evidence for the intervention by conducting a systematic literature review of relevant evidence. In addition, exploratory studies are needed to identify potential intervention components and to assess the needs of the target population in relation to the proposed behaviour change (Craig et al., 2008). It is critically important at this stage to fully describe how theory and evidence are translated into intervention content, so that the ways in which the intervention might influence the outcome can be evaluated, and the intervention can be reproduced and implemented as intended at later stages (Craig et al., 2008, Webb et al., 2010b, Michie and Aberdeen, 2012). For example, lack of transparency in reporting of the intervention content is a common problem in digital smoking cessation interventions; therefore, it is usually not clear what mechanisms might underlie their effectiveness, or lack thereof, and it is difficult to explain why some digital interventions are more effective to increase quit rates than others (Civljak et al., 2013).

After a pilot version of the intervention is assembled in the development stage, the next stage involves a series of feasibility and pilot studies to assess the acceptability and feasibility of the intervention process, including the recruitment and retention rates, and the expected effect size for the outcome. Evidence obtained at this stage can be used to inform the refinement of the intervention before its full-scale evaluation (Craig et al., 2008). Complex interventions that are found to be effective need to be widely disseminated and implemented, and the long-term effectiveness of interventions should also be assessed in the last stage, which can be used to inform future intervention development (Craig et al., 2008).

2.1.2. The Multiphase Optimization Strategy

Sharing the concept of a cyclical phase-based approach of the MRC guidance (Craig et al., 2008), the Multiphase Optimization Strategy (MOST) has been proposed as a comprehensive framework for optimizing and evaluating complex interventions efficiently (Collins et al., 2011, Collins et al., 2007). Inspired by principles of engineering (Rivera et al., 2007), MOST suggests that in the process of developing and evaluating complex interventions, research resources (e.g. participants, time and money) need to be managed strategically in order to gain as much reliable information as possible, whereby facilitating intervention science to progress fastest ('resource management' principle). In addition, when an optimized intervention is released, a new cycle of optimization should immediately begin to make incremental and cumulative progress in behaviour change interventions ('continuous optimization' principle) (Collins et al., 2011).

MOST recognizes that it is of fundamental importance to test the effects of individual intervention components and the optimal level of each component to maximise the overall effect of an intervention (Collins et al., 2011, Collins et al., 2007). According to this framework, an 'intervention component' is any aspect of a given intervention that can be separated out for study, such as aspects of the content (e.g. messages to increase motivation to stop smoking), mode of delivery (e.g. face-to-face support) or the environment in which the intervention is implemented (e.g. school-based intervention) (Collins et al., 2011). However, intervention components should be meaningful on their own and distinct from one another, and they should not involve time-sequence in order to be tested experimentally as part of MOST (Collins et al., 2007). Moreover, all combinations of intervention components

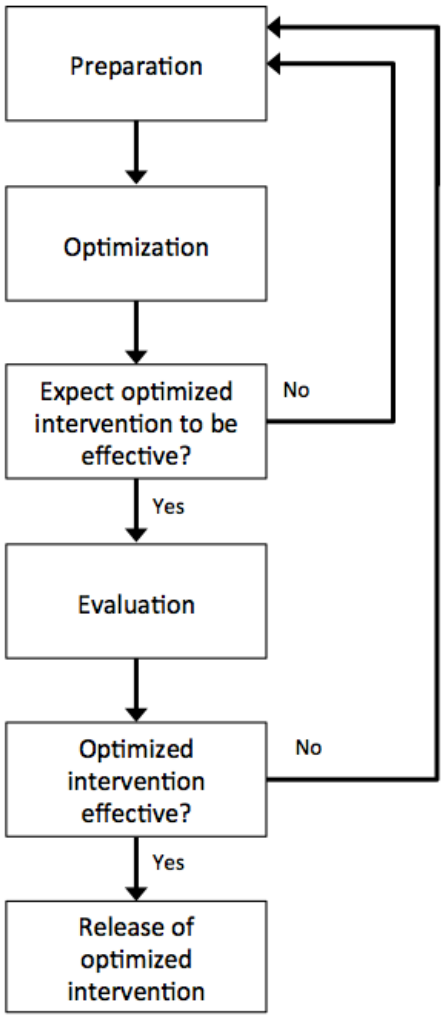
should be implementable (Chakraborty et al., 2009).

Figure 3 shows the process of intervention development and optimization in MOST (Collins et al., 2011). It begins with the 'preparation' stage, in which a number of potential intervention components are selected based on the identified scientific evidence and one or more theoretical frameworks. Generally, different levels of each component are also specified as part of this stage, such as a component can be present versus absent in the intervention, or can be included with different intensity levels (e.g. brief advice versus intensive counselling) (Collins et al., 2011). In the 'optimization' stage, selected intervention components with different levels of each component are tested in a randomised screening experiment, such as in a full factorial or fractional factorial experiment, which allows the testing of the effects of independent variables simultaneously. Ultimately, the aim of a screening experiment is to identify active components that can cause change in the behavioural outcome and screen out the least effective ones (Collins et al., 2014, Chakraborty et al., 2009). Intervention components that meet pre-specified screening criteria (e.g. statistically significant main effect of the component, or specific effect size) are usually included in the intervention for further evaluation (Collins et al., 2014, Whyrick et al., 2014).

According to MOST, RCTs are essential in the process of developing and evaluating multicomponent interventions. However, it is suggested that prior to the evaluation of a multicomponent intervention as a treatment package in a full-scale RCT ('evaluation' stage), individual effects of intervention components have to be assessed in order to inform decisions regarding a set of components and component levels that would be expected to contribute to an effective optimized intervention (Collins et al., 2011, Collins et al., 2013, Collins et al.,

2014). Following a successful evaluation stage, in which a RCT confirms that the intervention as a whole has a statistically significant effect compared with a control intervention, an optimized intervention includes one of the best possible sets of effective intervention components with an optimal level of each component taking into account any research constraints. In the final phase, optimized interventions should be implemented and used as a basis for subsequent cycles of intervention optimization.

Figure 3: The process of developing and optimizing complex interventions according to the Multiphase Optimization Strategy (Collins et al., 2011)

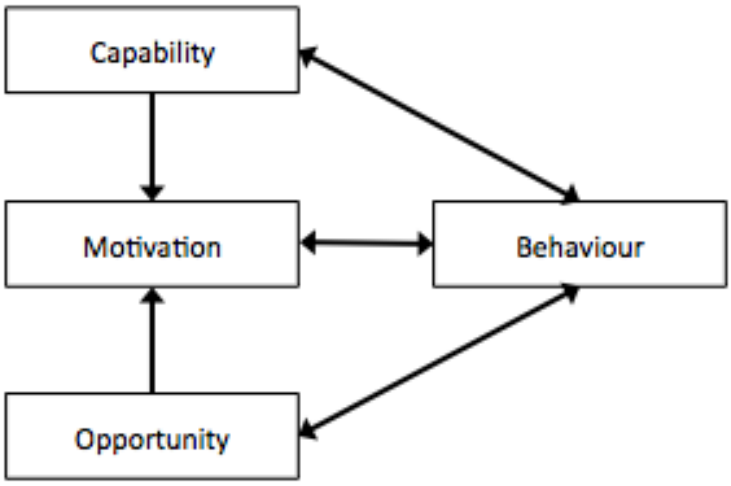


2.1.3. The Behaviour Change Wheel

Both the MRC guidance (Craig et al., 2008) and the MOST framework (Collins et al., 2011) recommend using a theoretical framework that can explain the mechanisms through which the intervention is expected to influence behaviour change, and the selection of potential intervention components that would be necessary to achieve that change. In order to improve intervention design at this initial stage, the Behaviour Change Wheel (BCW) has been developed to provide a comprehensive framework for systematically analysing the target behaviour, and selecting intervention options and specifying the intervention content accordingly (Michie et al., 2011d, Michie et al., 2014a).

The BCW proposes that developing behaviour change interventions requires a fundamental understanding and a thorough assessment of the behaviour in question. Therefore, after defining the problem in behavioural terms that the intervention aims to address (e.g. reducing cigarette smoking in pregnant women), it is important to select and specify the target behaviour, (e.g. stopping smoking completely), and identifying the ways in which people and/or their environment need to change in order to achieve the desired change in the target behaviour (Michie et al., 2014a). For the latter, the BCW uses the COM-B ('Capability', 'Opportunity', 'Motivation' and 'Behaviour') model to understand the target behaviour in its context (Michie et al., 2011d, Michie et al., 2014a). Main components of the COM-B model and the interactions between them are shown in Figure 4.

Figure 4: The COM-B model of behaviour (Michie et al., 2011d, Michie et al., 2014b)



The COM-B model suggests that at any moment three interacting conditions are necessary for any behaviour to occur, because people need to have the necessary capability (psychological and physical capability) to perform the behaviour, have the opportunity (afforded by the social and physical environment) to engage in the behaviour, and have strong enough motivation (automatic and reflective) to generate the behaviour (Michie et al., 2011d, Michie et al., 2014b). Understanding which one or more of the COM-B components promote or constrain the target behaviour in the selected population can directly inform further intervention design and it can contribute to maximising the effectiveness of specific intervention components targeting important influences on behaviour (Michie et al., 2011d, Michie et al., 2014b).

Based on a COM-B behavioural analysis, the BCW provides a guide for linking potential intervention targets with one or more of nine broader intervention functions identified in the literature, such as education, incentivisation or modelling (Michie et al., 2011d, Michie et al.,

2014a). Intervention functions can be linked with one or more of seven policy categories, such as guidelines, regulation or service provision, that would be needed for the intervention to be implemented in 'real-world' settings (Michie et al., 2011d, Michie et al., 2014a). According to the BCW, as part of the final steps of designing interventions, a set of specific BCTs needs to be carefully selected from a dedicated taxonomy, such as the Behaviour Change Techniques Taxonomy v1 (BCTTv1) (Michie et al., 2011a, Michie et al., 2013a) to deliver intervention content in line with the identified intervention functions (Michie et al., 2014a). Finally, the most appropriate mode of delivery of the intervention needs to be considered taking into account as many criteria as possible, so that the intervention is delivered affordably, practicably, (cost-) effectively, acceptably, safely and equitably across the target population (Michie et al., 2014a).

2.2. Theoretical framework

2.2.1. The COM-B model and the PRIME theory of motivation

There are many different theoretical approaches one might take towards design of complex interventions in general and smoking cessation interventions in particular (Michie et al., 2014b). This thesis uses the COM-B model (Michie et al., 2011d, Michie et al., 2014b) and the PRIME theory of motivation (West and Brown, 2013, West, 2006b) as its core theoretical frameworks for the intervention development. The reason for this is that they provide comprehensive and parsimonious models to account for individual behaviours or behaviour patterns in context, such as smoking, and the influences condition the change in that pattern, which can be tested through observations (Michie et al., 2013b).

The COM-B model is a broader model of behaviour (Michie et al., 2011d, Michie et al., 2014b). As discussed in Chapter 2.1.3., it is in the hub of the BCW and provides the basis for a systematic specification of intrapersonal and environmental factors and the interaction between them that enable or hinder behaviour to be performed and potentially to be changed (Michie et al., 2011d, Michie et al., 2014a). The key tenet in COM-B model is that people's capability, opportunity and motivation permit any given behaviour to occur at any moment, such as reducing smoking to a specific number of cigarettes during pregnancy (Michie et al., 2011d, Michie et al., 2014b). In terms of its system approach, the COM-B model recognizes that increasing people's physical and psychological capability to perform a particular behaviour and/or improving their psychological and environmental opportunity might increase their motivation to engage in that behaviour. On the other hand, increasing people's motivation per se cannot directly influence their capability or opportunity to perform the behaviour. Nevertheless, reciprocal associations exist between behaviour and its components; therefore, engaging in the behaviour can influence people's capability, opportunity and motivation (Michie et al., 2011d, Michie et al., 2014b).

Conceptually, PRIME theory (West and Brown, 2013, West, 2006b) fits within the COM-B model (Michie et al., 2011d, Michie et al., 2014b), as it seeks to draw together the full range of motivational influences on behaviour from plans, analysis and beliefs to emotions and habits. It provides an overarching model for understanding addiction, as discussed in detail in Chapter 1.3., and it recognises the importance of 'the moment' in the control of behaviour and the potential conflict between beliefs about what is beneficial or harmful and momentary desires and impulses.

A central tenet of PRIME theory is that images and thoughts about oneself as one is at present or aspires to become in the future, and the feelings attached to these (i.e. current and aspirational identities) are potentially a very powerful source of motives (wants and needs) (West and Brown, 2013, West, 2006b). It is argued that identity is also a source of self-control (West and Brown, 2013, West, 2006b), which is the cognitive capacity and motivation to deliberately regulate one's behaviour by shifting attention away from immediate temptations to avoid acting on impulses and emotional responses (Baumeister et al., 1994).

According to PRIME theory, 'identity' comprises self-images, self-feelings and self-thoughts, which are classified into self-labels (the categories people think they belong to), self-attributes (the features people ascribe to themselves, including self-efficacy and self-esteem) and personal rules (principles governing what people do and do not do) (West and Brown, 2013, Michie et al., 2014b, West, 2006b). As long as identifying oneself with a particular identity is personally important and makes the person feel good about it, it will provide a potentially high degree of stability to a specific behaviour pattern (West and Brown, 2013). PRIME theory further proposes that 'identity change' is an important driver of 'behaviour change', because taking on new self-images and new self-labels can lead up to defining new boundaries around a set of behaviours that people do and do not do in accordance with their new identities. Therefore, identity change can contribute to sustained behaviour change by strengthening and activating self-control in relevant moments, so that people act in line with self-conscious plans and beliefs when competing desires and impulses arise from the immediate situation (West and Brown, 2013, West, 2006b).

2.2.2. Identity and its role in behaviour and behaviour change

Identity has been studied within a variety of disciplines, including psychology, sociology, anthropology, philosophy and linguistics, and its literature is rooted in a number of different theoretical traditions (Vignoles et al., 2011), such as developmental psychology (Erikson, 1980), social and contextual perspective (Tajfel and Turner, 1986) or self-psychology (Markus and Nurius, 1986, James, 1890). These approaches differ markedly in how they construe identity, including its definition, the processes through which it operates (deliberate identity processes, such as committing oneself to an ideology, or automatic identity processes, such as defending an identity aspect), and how it is developed (discovered or socially constructed; through long-term developmental processes or short-term fluctuations; and primarily during dedicated times of the lifespan, such as during adolescence, or throughout the lifespan) (Vignoles et al., 2011).

An integrative perspective proposes that identity simultaneously has personal (including values, beliefs, self-esteem, personal characteristics, aspirational and feared future identities), relational (encompassing the person's roles and positions in relation to other people) and collective contents (arising from a person's identification with social groups and broader social categories), and that coexisting identity aspects are established, maintained and revised through conscious or automatic processes depending on the intra-/interpersonal and sociocultural contexts throughout the life span (Vignoles et al., 2011). This thesis uses the premises of this comprehensive perspective as basis for its conceptual view on identity, and defines identity, in accordance with PRIME theory, as a psychological construct that comprises people's mental representations of themselves, including their thoughts (self-

labels, attributes and personal rules) and images about themselves as they are at present and as they aspire to become in the future, and the feelings they attach to these (West and Brown, 2013, West, 2006b).

Identity has been recognized as driving behaviour, and theories of motivation and behaviour change have suggested different ways through which this influence might be operating. One of the earliest theories that aim to explain the role identity plays in behaviour is the Social Identity theory of intergroup behaviour (Tajfel and Turner, 1986). This theory suggests that people identify themselves with the social groups to which they belong, evaluate the meanings, beliefs and feelings they attach to their group memberships, and they are motivated to act in ways that maintain or result in a positive social identity. Therefore, as long as a person values identification with a specific social group (e.g. family, friends, a neighbourhood or broader social categories), in which smoking is acceptable, or is even a norm, it can contribute to smoking initiation and maintenance, and it can be an important barrier to quitting smoking.

Building on these premises, the Identity-based Motivation theory (Oyserman et al., 2007, Oyserman, 2007, Oyserman, 2009) emphasizes that people are motivated to engage in identity-congruent behaviours regardless of the costs or benefits of the behaviour. It argues that current or possible identities (aspirational or feared future identities) triggered by the context in any given moment will influence people's action readiness (self-control to engage in identity-congruent behaviour) and procedural readiness (making sense of the world by using identity-congruent cognitions). For example, a salient non-smoker identity in a particular social context might strengthen self-control and evoke plans and strategies to

maintain smoking abstinence; whereas, a salient social smoker identity could contribute to a lapse.

A bidirectional relationship between identity change and behaviour change is emphasized in Identity Change theory (Kearney and O'Sullivan, 2003). It posits that a conflict between values/goals and behaviour initiates a step towards behaviour change (e.g. substantially reducing the number of cigarettes) and if successful, this behaviour change can lead to an identity shift (e.g. from being a 'smoker' to 'non-smoker') that will further strengthen the new behaviour (e.g. stopping smoking completely).

Finally, PRIME theory (West and Brown, 2013, West, 2006b) adds to these debates by placing identity within a comprehensive and hierarchically structured model of the motivational influences on behaviour, including automatic responses and impulses, motives, and self-conscious evaluations and plans, as detailed in Chapter 1.3. It is argued in PRIME that identity can influence behaviour in at least three important ways. First, identity can generate potentially strong wants and needs (e.g. a want or need to be a non-smoker) against competing motives; thus, it can provide stability to a behaviour pattern. Secondly, it can drive behaviour change (e.g. making a quit attempt) in order to live up to personal commitments arising from a new identity (e.g. a personal rule of not smoking cigarettes). Finally, it can increase self-control and reduce mental-energy needed to sustain behaviour change by placing clear boundaries around a new behaviour pattern (e.g. sticking to a personal 'not a puff' rule). Further details are discussed in Chapter 2.2.1.

In terms of the underlying mechanisms of the motivational properties of identity, it has been

proposed that identities differ in the extent to which they are central (identities that are readily accessible) versus peripheral, essential (subjectively perceived as intrinsic or inevitable) versus accidental, and important (embedded in motives and emotions) versus immaterial to a person (Gregg et al., 2011). The more an identity aspect is central, essential and important, the more a person is likely to be committed to it and the more it will have the potential to drive behaviour (Gregg et al., 2011). The Motivated Identity Construction theory posits that people's 'identity motives', operating both consciously and outside people's conscious awareness, provide the basis for any identity processes to potentially drive behaviour and thus explain what people might seek when they want to adopt, maintain and defend or avoid certain identity aspects by engaging in particular behaviours or behaviour patterns, such as health behaviours, consumer behaviours or even extreme forms of violent acts against other people (Vignoles, 2011, Vignoles et al., 2006b).

Identity motives are defined as "tendencies toward certain identity states and away from others, which guide the processes of identity definition and enactment" (Vignoles, 2011, p. 405). The Motivated Identity Construction theory (Vignoles, 2011, Vignoles et al., 2006b) suggests that over and above the identity motive for 'self-esteem' (Gregg et al., 2011), five additional identity motives have been identified in the literature that energize and direct the way people think and feel about themselves, and these identity motives can have a direct role in motivating behaviour (Vignoles, 2011, Vignoles et al., 2006b). It is proposed that the identity motives for 'continuity' (the need for identities that provide some sense of connection between one's past, present and future identities despite significant life changes), 'distinctiveness' (the need for identities that provide feelings of individual or in-group distinctiveness) and 'meaning' (the need for identities that provide meaning and purpose in

one's existence) form the primary basis for identity definition. The identity motives for 'efficacy' (the need to strive for identities that provide feelings of competence and control) and 'belonging' (the need for identities that maintain or enhance feelings of social acceptance) are particularly important in identity enactment, and the identity motive for 'self-esteem' (the need to strive for identities that provide greater sense of self-worth) can be relevant in identity definition and enactment (Vignoles, 2011, Easterbrook and Vignoles, 2012). Identities that satisfy identity motives are likely to be perceived as central and important in current identity definition (Vignoles et al., 2006b), and they are desired as future identities (Vignoles et al., 2006a); consequently, they can drive identity enactment and influence behaviour to construct, maintain or defend these identities (Vignoles, 2011, Vignoles et al., 2006b).

CHAPTER 3 – AIMS AND OBJECTIVES OF THE THESIS

3.1. Aims and objectives of each strand of work reported in the thesis

Evidence suggests that although face-to-face behavioural support can increase cessation rates in pregnant smokers (Chamberlain et al., 2013), it has low uptake (Tappin et al., 2010). Digital interventions offer the potential for delivering behavioural support in a way that might be popular among pregnant smokers (Soklaridis et al., 2014, Herbec et al., 2014a, Naughton et al., 2013b) and might address some of the known barriers to stopping smoking in pregnancy (Ingall and Cropley, 2010); however, previous RCTs have not found statistically significant effects of these programmes to improve quit outcomes during pregnancy (Pollak et al., 2013, Naughton et al., 2012, Herbec et al., 2014b). More research is needed to advance our understanding of effective and attractive approaches to aid smoking cessation during pregnancy, and the ways in which such interventions should be configured and delivered.

This PhD research programme aims to begin the process of filling this evidence gap by undertaking essential background research and developmental studies with a view of creating a smoking cessation smartphone app for pregnant smokers that is suitable for intervention optimization. This thesis recognizes the potentially pivotal role identity can play in behaviour change; therefore, a considerable emphasis is placed on a better understanding of this construct in relation to smoking and cessation. Consequently, two strands of work are reported in this thesis with the overall aim of creating a smoking cessation smartphone app that harnesses identity change to aid smoking cessation in pregnant smokers.

3.1.1. Summary of studies related to smoker identity

The first strand of work related to the identity research and involved three studies of smokers and ex-smokers: two prospective studies using data from a large population survey of adults in England – the 'Smoking Toolkit Study' (Fidler et al., 2011) – and a meta-ethnography. The overarching aims of these studies were to advance understanding of the 'smoker identity' construct and of its potential influence on behaviour at various stages of the smoking cessation process: from a quit attempt though quit success to maintained abstinence.

Study 1 used data from the Smoking Toolkit Study to advance understanding of 'positive smoker identity' as a potential determinant of quit attempts and quit success in current smokers. This study addressed three research questions in relation to the general population and childbearing age women, and it aimed to: 1) provide an estimate for the proportion of current smokers who report a positive smoker identity in a nationally representative sample; 2) examine the demographic and smoking-related characteristics, and smoking-related attitudes that might be associated with positive smoker identity; and 3) assess the prospective predictive relationship between a positive smoker identity for quit attempts and quit success.

Study 2 used data from the same national household survey to examine 'non-smoker identity' as a potential predictor of long-term abstinence in ex-smokers who quit smoking in the past year. This study addressed three research questions in relation to the general population and childbearing age women, where data were available, and it aimed to: 1) provide an estimate for the proportion of ex-smokers who report a non-smoker identity following a quit attempt in a nationally representative sample; 2) examine the demographic and smoking-related

characteristics that might be associated with non-smoker identity following quitting; and 3) assess the prospective predictive relationship between a post-quit non-smoker identity for long-term quit success.

Study 3 involved a systematic literature review of qualitative research relating to smoker identity of young adults, and it used the meta-ethnographic method of synthesising qualitative evidence. This study aimed to provide insights into: 1) how young adult smokers and ex-smokers perceive their smoker identity, and what factors shape their beliefs, meanings and attitudes attached to it; 2) the extent to which smoker identity changes preceding or following smoking cessation; and 3) the ways in which smoker identity potentially influences behaviour in relation to smoking.

3.1.2. Summary of studies related to the intervention development

The second strand of work related to the development of the smoking cessation smartphone app itself. This line of research consisted of three studies: a qualitative interview study with pregnant smokers, a focus group study with HCPs who interact with pregnant smokers, and a quantitative analysis of the BCT content of an existing smoking cessation website for pregnant smokers (MumsQuit). The overarching aims of these studies were to identify potential intervention components with a possible set of BCTs delivering the content that could be included in the smartphone app to aid smoking cessation during pregnancy.

Study 4 used qualitative interviews with pregnant smokers and involved a COM-B behavioural analysis (Michie et al., 2014a) to specify potential intervention targets for the

smoking cessation app. This study aimed to obtain in-depth understanding of pregnant smokers' views regarding intrapersonal and extrapersonal factors that might enable or hinder smoking cessation during pregnancy. In particular, this study explored what would need to change in terms of pregnant smokers': 1) capability; 2) opportunity; and 3) motivation in order to alter their smoking behaviour.

Study 5 involved focus groups with HCPs, who provide smoking cessation support for pregnant women in England, to solicit their views regarding digital smoking cessation interventions in order to inform the design and delivery of the smoking cessation app. This study aimed to explore HCPs' views regarding: 1) the use of digital interventions to aid cessation; 2) potential ways in which such interventions can be used to engage pregnant smokers with smoking cessation support; and 3) the content, design and delivery features of digital interventions that might meet the needs of pregnant smokers.

Study 6 used data that were collected in a pilot RCT of the MumsQuit smoking cessation intervention for pregnant smokers and involved the content specification of the website by BCTs to inform the intervention component selection for the app. This study aimed to: 1) assess the associations between pregnant smokers' demographic and smoking-related characteristics and engagement with MumsQuit; 2) identify BCTs in the content of the MumsQuit intervention using the BCTTv1; and 3) conduct a preliminary assessment of the associations between pregnant smokers' exposure to particular BCTs and short-term quit success.

CHAPTER 4 – POSITIVE SMOKER IDENTITY AND ITS ROLE IN QUIT ATTEMPTS AND QUIT SUCCESS (STUDY 1)

4.1. Abstract

'Positive smoker identity' may be an important factor undermining smoking cessation but very little research exists on this. This study assessed whether a simple measure of positive smoker identity would predict quit attempts over and above other known predictors in a population sample. More tentatively it explored whether this measure would also predict quit success. A representative sample of adult smokers in England (n=9,456) was included at baseline. Of these, 1,745 were childbearing age women (age 16-34). At six months, 2,099 and 317 were followed up, respectively. Demographic and smoking-related characteristics, a measure of positive smoker identity (endorsing the statement: 'I like being a smoker'), measures of smoking-related attitudes, quit attempts and quit success were included. Of current smokers, 18.3% in the general population and 12.9% in a subsample of young women reported a positive smoker identity. Both in the general population and in young women, older age, higher nicotine dependence, lower motivation to stop and enjoyment of smoking were associated with a positive smoker identity after adjusting for all predictors. In the general population, having a positive smoker identity independently predicted failure to make a quit attempt at six months, and the independent association with quit success was similar in magnitude and was in the negative direction, but did not reach statistical significance. This study concludes that only a minority of smokers in England have a positive smoker identity. However, where it is present it may be an important barrier to quitting smoking.

4.1.1. Dissemination

A version of this chapter has been published in *Drug and Alcohol Dependence* (reported in Appendix A-1). Details of this publication are as follows.

Tombor, I., Shahab, L., Brown, J., West, R. (2013). Positive smoker identity as a barrier to quitting smoking: Findings from a national survey of smokers in England. *Drug and Alcohol Dependence*, 133, 2, 740-745. Doi: 10.1016/j.drugalcdep.2013.09.001.

4.2. Introduction

Studies have consistently found that variables related to motivation to stop smoking (e.g. health concerns and enjoyment of smoking) are consistently predictive of quit attempts but less so of success of those attempts, whereas measures related to nicotine dependence (e.g. the Fagerström Test for Cigarette Dependence) are consistently predictive of quit success but less so of quit attempts (Vangeli et al., 2011). One important concept that so far has not been explored and which might have an impact on both quit attempts and success is what might be termed 'positive smoker identity'. If this construct is related to quit attempts and/or success, it may be an important target for messaging aimed at promoting smoking cessation.

Both current identity and aspirational identity aspects have positive and negative feelings attached to them that themselves can be a powerful source of wants and needs, which in turn are regarded as the primary drivers of purposeful behaviour, as discussed in Chapter 2.2. (Vignoles, 2011, Oyserman and James, 2011, West, 2006b, West and Brown, 2013).

Following the principle of parsimony, a positive smoker identity, one's positive feelings attached to the identity as a smoker, could be assessed by endorsement of the statement 'I like being a smoker'. For obvious reasons a positive smoker identity would be expected to deter smokers from trying to quit, but the strength of this relationship has not been evaluated. Neither is it known whether the prediction is over and above other key variables such as health concerns and enjoyment of smoking. It is possible that a smoker may enjoy smoking and not be concerned about the health consequences of smoking but has not integrated these attitudes into a sense of pleasure or satisfaction about being a smoker. Conversely, a smoker may not derive any pleasure or satisfaction from the act of smoking or the pharmacological effects of nicotine and may accept that smoking is damaging to the health but nevertheless can gain pleasure or satisfaction from self-identifying as a smoker. Positive smoker identity may also predict quit success where other motivational variables do not. This is because of the intrinsic motivational force of identity and its persistence.

Little research has been published on smoker identity. The majority of findings relating to the role of smoker identity in cessation have been reported in studies based on qualitative methods. It has been shown that both adult (Vangeli and West, 2012) and young smokers (Johnson et al., 2003) report shifting between different smoker identities (e.g. from 'smoker' to 'non-smoker') during the process of cessation. There is some evidence that smokers make efforts to distance themselves from their unwanted smoker identity (Thompson et al., 2009, Hoek et al., 2013b, Brown et al., 2011), and that pregnant smokers' motivation to quit smoking during pregnancy can often be grounded in a strong need to establish a moral identity as a non-smoker (Nichter et al., 2007). If this identity transition is not sufficient to achieve long-term abstinence, smokers can carry on smoking secretly (Thompson et al.,

2009) or occasionally (Hoek et al., 2013b, Brown et al., 2011); whereas, those with a strong non-smoker identity are more likely to remain abstinent (Johnson et al., 2003, Nichter et al., 2008).

Quantitative studies suggest potential discrepancies between smoker identity and behaviour, that is, despite smoking cigarettes people deny being a smoker (Choi et al., 2010, Ridner et al., 2010, Berg et al., 2009, Levinson et al., 2007). Those denying their smoker identity tend to be younger, male (Berg et al., 2009), and smoke occasionally (Levinson et al., 2007) and they are less likely to make a quit attempt in the past year (Berg et al., 2009). There is some evidence that having developed a smoker identity is associated with smoking escalation in adolescents (Hertel et al., 2012) and resistance to anti-tobacco messages (Falomir and Invernizzi, 1999, Freeman et al., 2001). Smokers with a smoker identity have been found in two studies to be less likely to intend to (Falomir and Invernizzi, 1999) and make a quit attempt (van den Putte et al., 2009). Moreover, smoker self-concept and abstainer self-concept at baseline were reported to be important factors in predicting the success of smoking cessation treatments among adults (Shadel and Mermelstein, 1996).

4.2.1. Aims and research questions

Overall, the literature on smoker identity suggests that positive smoker identity could play a role in both quit attempts and quit success, but the picture is not clear, and no study has examined this construct in a representative sample of smokers. Therefore, this study aimed to advance understanding of determinants of smoking cessation by examining the prospective predictive relationship between positive smoker identity for quit attempts and quit success.

The following research questions were addressed in the general adult population and in a subsample of childbearing age women:

1. What is the proportion of smokers in a nationally representative sample who report a positive smoker identity?
2. What demographic and smoking-related characteristics, and smoking-related attitudes are associated with positive smoker identity?
3. What is the predictive relationship between positive smoker identity for quit attempts and quit success at six months follow-up?

4.3. Methods

4.3.1. Study design

Data were collected as part of the Smoking Toolkit Study (www.smokinginengland.info) (Fidler et al., 2011). The Smoking Toolkit Study is ongoing and involves: 1) a series of monthly household surveys monitoring national smoking and smoking cessation figures and related behaviour patterns in representative samples of adults age 16 and over in England, and 2) postal follow up of each monthly wave six months later. A random location sampling design is used in the Smoking Toolkit Study, which is a hybrid between random probability and simple quota sampling. First, England is split into 171,356 output areas (containing approximately 300 households). Output areas are then stratified by ACORN characteristics, an established geo-demographic analysis of the population (http://www.caci.co.uk/acorn/acornmap.asp), and region. Grouped output areas are randomly

allocated to interviewers, who conduct face-to-face computer assisted interviews. Interviews from each selected output area are conducted until quotas are fulfilled, which are based on factors influencing the probability of being at home (i.e. working status, age and gender). Each month a new sample of approximately 1,800 people (one adult member of each selected household) completes a face-to-face computer assisted baseline interview with a trained interviewer carried out by the Taylor Nelson Sofres-British Market Research Bureau. The University College London (UCL) ethics committee approved the Smoking Toolkit Study.

4.3.2. Participants

Measures used in the current study were included between June 2010 and March 2012, during which 43,079 adults aged 16 and over participated in the Smoking Toolkit Study. A representative sample of current cigarette smokers who reported smoking cigarettes (including hand-rolled) either every day or occasionally, and provided data for all variables included in the analyses comprised the baseline sample of the general population (n=9,456); of these 1,745 were women age 16-34. This particular age range of participants in the subsample of childbearing age women was selected, because the majority of women in England and Wales give birth before their mid-thirties (Office for National Statistics, 2014b).

At six months follow-up, 2,099 (22.2%) adults from the general population completed the questionnaire, and 317 (18.2%) from the subsample of childbearing age women. The follow-up rate is typically low for this kind of household survey because it seeks to maximise representativeness of the baseline survey and so those taking part in the baseline survey do not necessarily have any interest in being followed up. Although the follow-up rate was low,

the sample followed up has been found to be similar on key variables to those not followed up (Fidler and West, 2010, Smit et al., 2011, Beard et al., 2013).

4.3.3. Measures

Data on demographic characteristics, including gender, age and social-grade, were collected. Social grade was measured according to the British National Readership Survey classification system and dichotomised into ABC1 (those with higher and intermediate professional/managerial, supervisory, clerical, junior managerial/administrative/professional occupations) and C2DE (those with skilled, semi-skilled and unskilled manual, and lowest grade occupations, or unemployed).

Attitudes to smoking were assessed with: 'How do you feel about being a smoker?', and participants stated whether they agreed ('Yes' or 'No') with the following statements: 'I like being a smoker', 'I enjoy smoking', 'I am addicted to smoking', 'I am confident I could stop if I tried', 'I am worried that smoking is harming my health right now', 'I am worried that smoking will harm my health in the future', 'I am worried about the effect of smoking on my family and loved ones' and 'Smoking is costing me too much money'. Participants could tick all that applied to them. According to the definition of 'positive smoker identity' used in this thesis, it was assessed by the agreement with the statement 'I like being a smoker'.

Other smoking characteristics were assessed as follows. Nicotine dependence was measured with the established Heaviness of Smoking Index (HSI), a composite measure of the numbers of cigarettes smoked per day and time to first cigarette (maximum score ranges from 0 to 6)

(Heatherton et al., 1989). Motivation to quit was assessed with the validated single-item measure: the Motivation to Stop Scale (MTSS) which ranges from 1 'not want to' to 7 'really want to and intend to in the next month', with higher scores indicating higher level of motivation to stop (Kotz et al., 2013a). Recent quit attempts were determined by asking participants 'Have you made a serious attempt to stop smoking in the past 12 months? By serious attempt I mean you decided that you would try to make sure you never smoked again. Please include any attempt that you are currently making' ('Yes' or 'No').

At six months follow-up, participants were asked whether they had made any serious attempt to stop in the past 12 months and those that answered 'Yes' were further asked: 'How long ago did your most recent serious quit attempt start' ('in the last week', 'more than a week and up to a month', 'more than 1 month and up to 2 months', 'more than 2 months and up to 3 months', 'more than 3 months and up to 6 months', 'more than 6 months and up to a year', 'can't remember') to assess whether any quit attempt had been made since baseline. A quit attempt was considered to be successful if a person had made a quit attempt during the follow-up period and answered 'No' to the question: 'Do you smoke cigarettes at all nowadays (including hand-rolled cigarettes)'.

4.3.4. Analysis

Prevalence of positive smoker identity was calculated by using weighted data to match the sample with the 2001 census on age, gender and social grade. Correlation coefficients were calculated to show the simple association between predictor variables in the logistic regressions. Pearson χ^2 and t-tests were used to compare the baseline characteristics of those

who were followed up and who were not followed up in the general population, and Pearson χ^2 was used to assess the association between smoker identity and time since the quit attempt in the follow-up sample. A series of univariable logistic regressions were conducted to examine the association of having a positive smoker identity with demographic and smoking characteristics as well as attitudes to smoking, and multivariable logistic regression analysis was used to evaluate the independent association of these characteristics with having a positive smoker identity. Similarly, the individual predictive relationship between positive smoker identity and quit attempts and quit success at six months follow-up was assessed by univariable logistic regression, and its predictive value for quit attempt and quit success independent from other predictors was evaluated by multivariable logistic regression. Given that this study aimed to explore potential determinants of smoking cessation, and specifically to evaluate the strength of associations between positive smoker identity and quit attempts and quit success over and above demographic characteristics, nicotine dependence and smoking related attitudes, potential moderator effects were not tested. Therefore, variables assessing participants' motivation to stop smoking and recent quit attempts were not included in the logistic regressions, because these are known predictors of quit attempts and it is expected that they might mediate the relationship between identity and behaviour.

4.3.5. Contributions

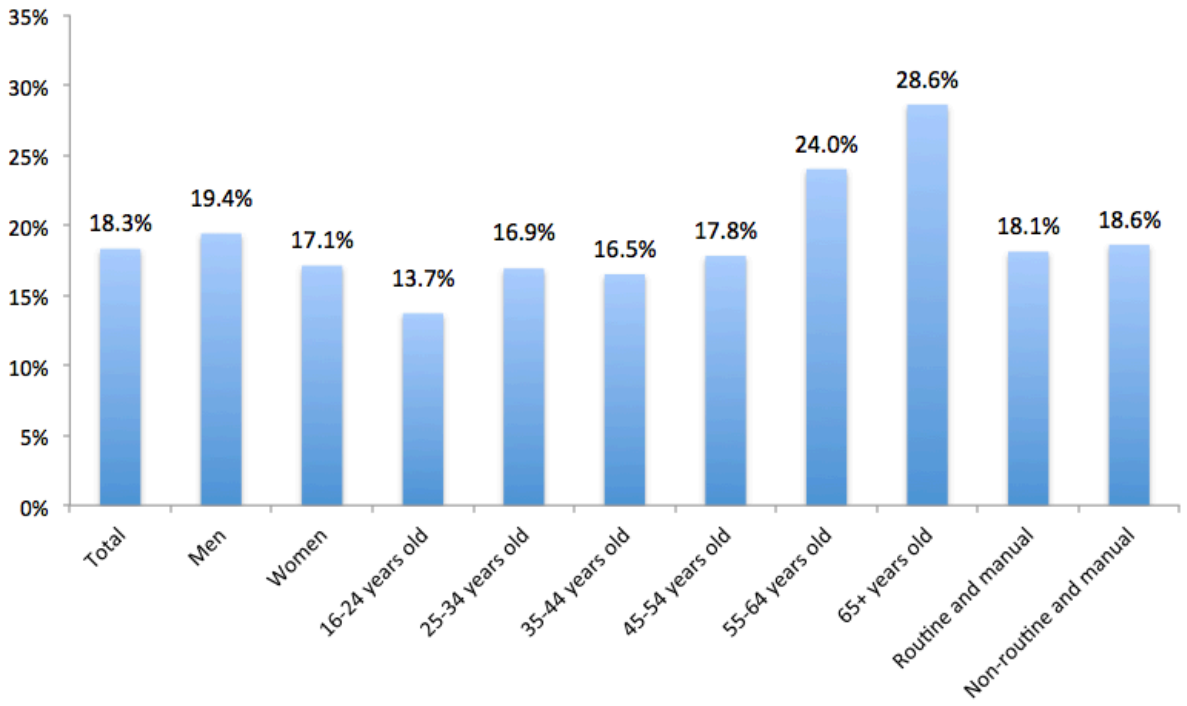
I conducted the literature search, analysed the data, and wrote up the study. Robert West designed the Smoking Toolkit Study, conceived the initial idea of this study and revised the write up of the study. Lion Shahab and Jamie Brown contributed to the write up of the study.

4.4. Results

4.4.1. Prevalence of a positive smoker identity among current smokers

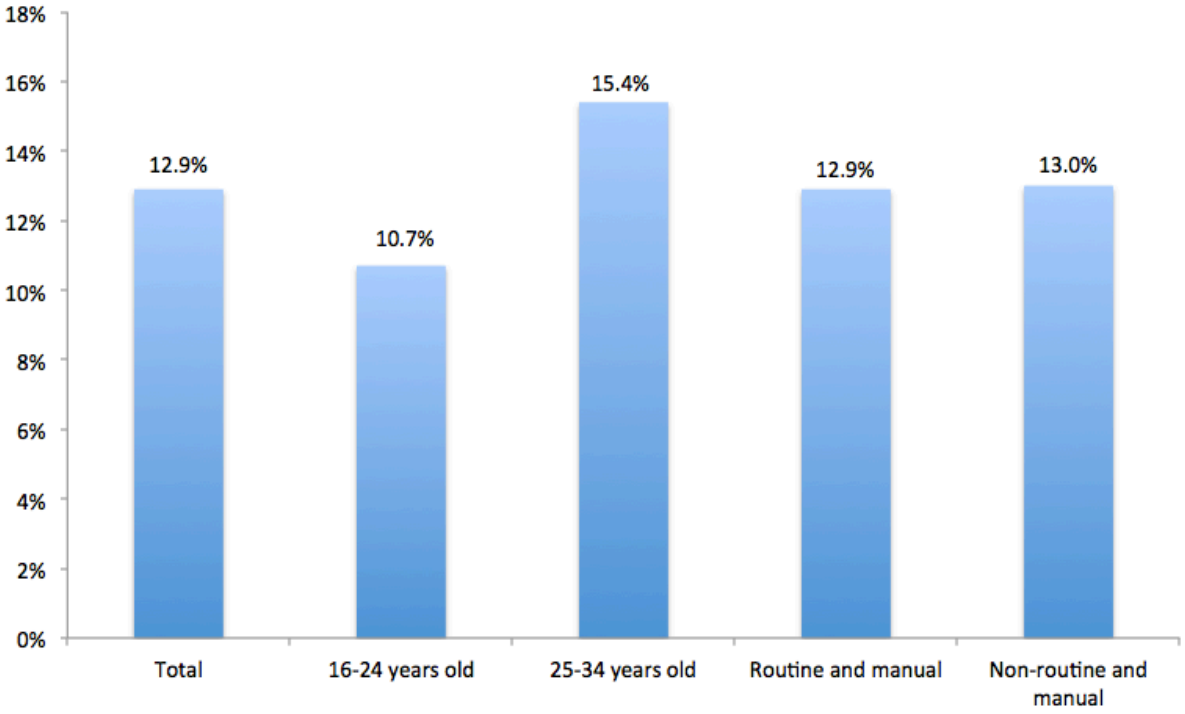
In the baseline sample (n=9,456), a total of 18.3% (95% CI=17.5-19.2) of adult smokers had a positive smoker identity, 19.4% (95% CI=18.3-20.6) of men and 17.1% (95% CI=16.0-18.3) of women. The prevalence of positive smoker identity ranged from 13.7% (95% CI=12.1-15.4) in the youngest (age 16-24) to 28.6% (95% CI=25.5-31.8) in the oldest age group (age 65 and over), and from 18.1% (95% CI=17.1-19.2) in low socioeconomic groups to 18.6% (95% CI=17.4-19.9) in higher socioeconomic groups (Figure 5).

Figure 5: Prevalence of a positive smoker identity among current smokers in the general population



When the baseline sample was restricted to women of childbearing age (n=1,745), 12.9% (95% CI=11.4-14.7) had a positive smoker identity. The prevalence was 10.7% (95% CI=8.7-13.0) in age 16-24 and 15.4% (95% CI=13.0-18.1) in age 25-34, and it ranged from 12.9% (95% CI=10.4-15.8) in low socioeconomic groups to 13.0% (95% CI=11.1-15.3) in higher socioeconomic groups (Figure 6).

Figure 6: Prevalence of a positive smoker identity among current smokers in childbearing age women (age 16-34)



4.4.2. Cross-sectional analyses at baseline

To assess collinearity, correlation coefficients were calculated between all predictor variables

in the logistic regressions. There was no indication that multicollinearity would introduce bias in the multivariable logistic regression models, since predictor variables did not correlate highly with each other. Results are reported only for the general population (Table 1).

Table 2 reports the cross-sectional logistic regression analyses in the general population. Having a positive smoker identity was associated with being older and male. In addition, those reporting stronger nicotine dependence, lower motivation to stop smoking and not having made a quit attempt in the past year were more likely to have a positive smoker identity. Enjoyment of and addiction to smoking, lower confidence in the ability to stop smoking, no current and future health concerns, no concerns about the effects smoking has on family and the cost of smoking were also associated with a positive smoker identity. There was no evidence of a significant difference as a function of social grade. In the multivariable logistic regression, age, gender, nicotine dependence, motivation to stop smoking, previous quit attempts, enjoyment of and addiction to smoking remained significant.

Table 3 shows the same cross-sectional analyses in women of childbearing age. Being older, having stronger nicotine dependence, having lower motivation and lower confidence in ability to stop smoking were associated with a positive smoker identity. Women who did not make a quit attempt in the past year, enjoyed smoking more and had no concerns about current health effects or the costs of smoking were more likely to have a positive smoker identity. After adjusting for all study variables, older age, stronger nicotine dependence, lower motivation to stop smoking and enjoyment of smoking were associated with a positive smoker identity.

Table 1: Correlation coefficients between predictive variables in logistic regressions calculated in the general population at baseline in Study 1 (n=9,456)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Positive smoker identity	1												
2. I enjoy smoking	0.18*	1											
3. I am addicted to smoking	0.06*	-0.01	1										
4. Heaviness of Smoking Index	0.09*	0.07*	0.24*	1									
5. I am confident I could stop if I tried	-0.07*	-0.18*	-0.18*	-0.19*	1								
6. I am worried that smoking is harming my health right now	-0.04*	-0.02*	0.23*	0.12	0.11*	1							
7. I am worried that smoking will harm my health in the future	-0.06*	-0.01	0.20*	-0.03*	0.14*	0.34*	1						
8. I am worried about the effect of smoking on family and loved ones	-0.04*	-0.05*	0.19*	0.02	0.11*	0.32*	0.29*	1					
9. Smoking is costing me too much money	-0.03*	0.001	0.19*	0.09*	0.07*	0.18*	0.15*	0.16*	1				
10. Motivation to Stop Scale	-0.27*	-0.31*	0.11*	-0.08*	0.23*	0.29*	0.29*	0.25*	0.18*	1			
11. Quit attempt in past year	-0.13*	-0.14*	0.08*	0.01	0.06*	0.16*	0.14*	0.14*	0.09*	0.39*	1		
12. Age	0.12*	0.16*	0.02*	0.08*	-0.10*	0.03*	-0.05*	-0.07*	-0.05*	-0.15*	-0.01*	1	
13. Gender	-0.03*	-0.01	0.02*	-0.05*	-0.01	0.04*	0.01	0.07*	0.06*	0.04*	0.04*	0.03*	1
14. Social grade	-0.001	-0.05*	-0.01	0.15*	-0.01	-0.02*	-0.06*	-0.001	0.02*	-0.01	0.01	0.02	0.02

*p<0.05; Note: where one or more of the variables is dichotomous the correlations are point-biserial and where both are they are tetrachoric.

Table 2: Associations between participants' baseline characteristics and positive smoker identity in the general population in Study 1

	Baseline sample (n=9,456)	No positive smoker identity (n=7,710)	Positive smoker identity (n=1,746)	Positive smoker identity vs. No positive smoker identity	
				OR (95% CI); p-value	Adj. OR[a] (95% CI); p-value
Women, % (n)	49.4 (4,674)	50.2 (3,874)	45.8 (800)	0.84 (0.76-0.93); p=0.001	0.87 (0.77-0.97); p=0.013
Age, Mean (SD), (increase in 10 years of age)	42.4 (16.8)	41.4 (16.5)	46.6 (17.6)	1.20 (1.16-1.24); p<0.001	1.11 (1.07-1.15); p<0.001
C2DE social grade, % (n)	69.3 (6,554)	69.3 (5,345)	69.2 (1,209)	1.00 (0.89-1.12); p=0.947	0.97 (0.86-1.09); p=0.610
Heaviness of Smoking Index, Mean (SD), (per point increase)	2.1 (1.5)	2.0 (1.5)	2.4 (1.5)	1.17 (1.13-1.21); p<0.001	1.09 (1.04-1.13); p<0.001
Motivation to Stop Scale, Mean (SD), (per point increase)	3.8 (2.0)	4.1 (2.0)	2.6 (1.9)	0.69 (0.67-0.71); p<0.001	0.71 (0.68-0.73); p<0.001
Quit attempt in past year, % (n)	31.7 (2,999)	34.5 (2,658)	19.5 (341)	0.46 (0.41-0.52); p<0.001	0.85 (0.74-0.98); p=0.025
I enjoy smoking, % (n)	43.9 (4,147)	39.6 (3,056)	62.5 (1,091)	2.54 (2.28-2.82); p<0.001	1.65 (1.47-1.86); p<0.001
I am addicted to smoking, % (n)	36.0 (3,401)	34.6 (2,669)	41.9 (732)	1.36 (1.23-1.52); p<0.001	1.58 (1.39-1.79); p<0.001
I am confident I could stop if I tried, % (n)	27.8 (2,628)	29.4 (2,265)	20.8 (363)	0.63 (0.56-0.72); p<0.001	1.15 (1.00-1.32); p=0.054
I am worried that smoking is harming my health right now, % (n)	26.3 (2,483)	27.2 (2,096)	22.2 (387)	0.76 (0.67-0.86); p<0.001	1.09 (0.93-1.27); p=0.284
I am worried that smoking is harming my health in the future, % (n)	33.0 (3,123)	34.3 (2,647)	27.3 (476)	0.72 (0.64-0.81); p<0.001	1.00 (0.87-1.15); p=0.988
I am worried about the effect of smoking on family and loved ones, % (n)	23.5 (2,222)	24.3 (1,871)	20.1 (351)	0.79 (0.69-0.89); p<0.001	1.12 (0.97-1.31); p=0.134
Smoking is costing me too much money, % (n)	44.0 (4,156)	44.6 (3,437)	41.2 (719)	0.87 (0.78-0.97); p=0.010	1.04 (0.93-1.17); p=0.509

[a] Adjusted for all other variables.

Table 3: Associations between childbearing age women's (age 16-34) baseline characteristics and positive smoker identity in Study 1

	Baseline sample (n=1,745)	No positive smoker identity (n=1,520)	Positive smoker identity (n=225)	Positive smoker identity vs. No positive smoker identity	
				OR (95% CI); p-value	Adj. OR[a] (95% CI); p-value
Age 25-34, % (n)	53.9 (941)	52.9 (804)	60.9 (137)	1.39 (1.04-1.85); p=0.025	1.46 (1.08-1.98); p=0.014
C2DE social grade, % (n)	72.0 (1.256)	72.0 (1,095)	71.6 (161)	0.98 (0.72-1.33); p=0.880	0.98 (0.71-1.39); p=0.985
Heaviness of Smoking Index, Mean (SD), (per point increase)	1.8 (1.5)	1.7 (1.5)	2.0 (1.6)	1.14 (1.04-1.25); p=0.005	1.12 (1.01-1.24); p=0.038
Motivation to Stop Scale, Mean (SD), (per point increase)	4.1 (2.0)	4.3 (1.9)	2.8 (1.9)	0.67 (0.62-0.73); p<0.001	0.69 (0.63-0.76); p<0.001
Quit attempt in past year, % (n)	37.9 (661)	39.9 (607)	24.0 (54)	0.48 (0.34-0.66); p<0.001	0.77 (0.54-1.10); p=0.156
I enjoy smoking, % (n)	33.1 (578)	30.5 (463)	51.5 (115)	2.39 (1.80-3.17); p<0.001	1.54 (1.13-2.10); p=0.007
I am addicted to smoking, % (n)	33.8 (590)	33.4 (508)	51.1 (115)	1.14 (0.85-1.53); p=0.371	1.33 (0.95-1.87); p=0.096
I am confident I could stop if I tried, % (n)	31.9 (557)	33.2 (504)	23.6 (53)	0.62 (0.45-0.86); p=0.004	0.93 (0.65-1.33); p=0.675
I am worried that smoking is harming my health right now, % (n)	23.3 (407)	24.2 (368)	17.3 (39)	0.66 (0.46-0.95); p=0.024	0.97 (0.63-1.50); p=0.887
I am worried that smoking is harming my health in the future, % (n)	33.8 (589)	34.4 (523)	29.3 (66)	0.79 (0.58-1.07); p=0.134	1.24 (0.86-1.79); p=0.258
I am worried about the effect of smoking on family and loved ones, % (n)	29.2 (509)	29.7 (452)	25.3 (57)	0.80 (0.58-1.10); p=0.176	1.23 (0.85-1.79); p=0.278
Smoking is costing me too much money, % (n)	49.2 (859)	50.5 (767)	40.9 (92)	0.68 (0.51-0.90); p=0.008	0.79 (0.58-1.08); p=0.144

[a] Adjusted for all other variables

4.4.3. Prospective analyses at six months follow-up

Table 4 shows the demographic and smoking characteristics of those who were followed up and who were not followed up at six months in the overall sample. Those completing the six-month questionnaire were more likely to be women, slightly older, enjoy smoking more and report addiction to smoking. The association between having a positive smoker identity and time since the most recent serious quit attempt started was also assessed at the follow-up sample, but no significant difference was found as a function of positive smoker identity (Pearson χ^2=3.441; df=4; p=0.487).

Table 5 reports logistic regression analyses in the general population assessing the predictive value of positive smoker identity for quit attempts and quit success in univariable analyses as well as in multivariable logistic regression independently from other demographic and smoking characteristics and smoking related attitudes. As regards barriers, those with a positive smoker identity and those who enjoy smoking more were less likely to have made an attempt to quit during the follow-up period of six months. Moreover, confidence in ability to stop smoking, future health concerns as well as worries about the effects of smoking on family were consistently found to be positive predictors of making a quit attempt. Although worrying about current health and cost of smoking were significant determinants in the univariable analyses, but these were no longer significant after adjusting for all other variables, while age was only significant in the fully adjusted model. In terms of predictors of quit success, positive smoker identity was not found to be significant and greater nicotine dependence predicted the failure to quit successfully at six months. In a sensitivity analysis, predictors of quit attempt and quit success were also both assessed in separate multivariable

regression models with the forward entry method, and in each case the variables were found to be significant predictors. In addition, a sensitivity analysis was carried out with a more stringent measure of quit success: a quit attempt was considered successful if started within six months but no later than one month at six-month follow-up; again, the pattern of results remained the same.

Table 6 reports the prospective logistic regression analyses in women of childbearing age. Enjoyment of smoking, lower confidence in ability to quit and lack of concerns about the effects smoking has on loved ones were significant barriers to making a quit attempt at six months. The same variables remained significant in the multivariable analysis. In the sensitivity analysis, in which the forward entry method was used in the multivariable regression, lower confidence in ability to quit and concerns about the effects smoking has on loved ones were significant predictors of not making a quit attempt. Given the small sample size of women who were followed up at six months and made a quit attempt in the six months from baseline (n=89), predictors of quit success were not assessed in the subsample of childbearing age women.

Table 4: Baseline characteristics of those who lost to follow-up and who were followed up at six months in the general population in Study 1

	Lost to follow-up at six months (n=7,357)	Followed up at six months (n=2,099)
Women, % (n)	47.8 (3,518)	55.1 (1,156)*
Age, Mean (SD)	41.0 (16.9)	47.0 (15.8)*
C2DE social grade, % (n)	69.1 (5,087)	69.9 (1,467)
Heaviness of Smoking Index, Mean (SD)	2.0 (1.5)	2.2 (1.5)*
Motivation to Stop Scale, Mean (SD)	3.8 (2.0)	3.7 (2.0)
Quit attempt in past year, % (n)	32.1 (2,359)	30.5 (640)
I enjoy smoking, % (n)	42.6 (3,136)	48.2 (1,011)*
I am addicted to smoking, % (n)	34.4 (2,534)	41.3 (867)*
I am confident I could stop if I tried, % (n)	28.4 (2,091)	25.6 (537)*
Positive smoker identity, % (n)	18.0 (1,323)	20.2 (423)*
I am worried that smoking is harming my health right now, % (n)	25.8 (1,897)	27.9 (586)*
I am worried that smoking will harm my health in the future, % (n)	32.6 (2.395)	34.7 (728)
I am worried about the effect of smoking on family and loved ones, % (n)	23.0 (1,690)	25.3 (532)*
Smoking is costing me too much money, % (n)	43.2 (3,179)	46.5 (977)*

*Significant difference between samples ($p<0.05$)

Table 5: Regression analysis with predictors of quit attempts in the followed-up sample in the general population at six months (n=2,099) and quit success in the sample of those who have made a quit attempt during the follow-up of six months (n=638) in Study 1

	Follow-up at six months			
	Quit attempt (n=2,099)		Quit success (n=638)	
	OR (95% CI); p-value	Adj. OR[a] (95% CI); p-value	OR (95% CI); p-value	Adj. OR[a] (95% CI); p-value
Positive smoker identity	0.61 (0.48-0.79); p<0.001	0.69 (0.53-0.91); p=0.007	0.58 (0.32-1.06); p=0.077	0.54 (0.29-1.01); p=0.053
I enjoy smoking'	0.66 (0.55-0.80); p<0.001	0.71 (0.58-0.87); p=0.001	0.95 (0.65-1.40); p=0.805	1.03 (0.68-1.55); p=0.904
I am addicted to smoking'	1.14 (0.95-1.38); p=0.163	1.14 (0.92-1.41); p=0.245	0.97 (0.67-1.43); p=0.892	1.26 (0.82-1.96); p=0.295
Heaviness of Smoking Index (per point increase)	0.94 (0.89-1.00); p=0.058	0.97 (0.90-1.03); p=0.300	0.83 (0.73-0.94); p=0.003	0.82 (0.72-0.94); p=0.004
I am confident I could stop if I tried'	1.70 (1.39-2.09); p<0.001	1.53 (1.22-1.92); p<0.001	0.96 (0.64-1.43); p=0.822	0.90 (0.57-1.41); p=0.637
I am worried that smoking is harming my health right now	1.61 (1.32-1.97); p<0.001	1.19 (0.94-1.51); p=0.143	0.86 (0.57-1.28); p=0.458	0.91 (0.56-1.47); p=0.691
I am worried that smoking will harm my health in the future	1.58 (1.30-1.91); p<0.001	1.28 (1.02-1.60); p=0.031	0.84 (0.57-1.24); p=0.375	0.79 (0.51-1.24); p=0.305
I am worried about the effect of smoking on family and loved ones	1.70 (1.38-2.09); p<0.001	1.41 (1.12-1.77); p=0.004	1.01 (0.68-1.52); p=0.945	1.16 (0.74-1.80); p=0.518
Smoking is costing me too much money	1.22 (1.01-1.47); p=0.036	1.07 (0.88-1.31); p=0.490	0.88 (0.60-1.28); p=0.500	0.97 (0.64-1.45); p=0.871
Age (increase in 10 years of age)	1.04 (0.98-1.11); p=0.191	1.10 (1.03-1.17); p=0.005	0.94 (0.83-1.06); p=0.323	0.96 (0.84-1.09); p=0.496
Women	0.95 (0.79-1.15); p=0.608	0.89 (0.74-1.08); p=0.251	0.92 (0.63-1.34); p=0.657	0.88 (0.60-1.30); p=0.524
C2DE social grade	0.98 (0.80-1.20); p=0.844	0.98 (0.80-1.21); p=0.853	0.67 (0.45-1.00); p=0.051	0.73 (0.48-1.10); p=0.132

[a] Adjusted for all other variables.

Table 6: Regression analysis with predictors of quit attempts in the follow-up sample in childbearing age women (age 16-34) at six months (n=317) in Study 1

	Follow-up at six months	
	Quit attempt (n=317)	
	OR (95% CI); p-value	Adj. OR[a] (95% CI); p-value
Positive smoker identity	0.83 (0.40-1.73); p=0.625	1.14 (0.51-2.53); p=0.755
I enjoy smoking	0.52 (0.30-0.89); p=0.017	0.52 (0.28-0.95); p=0.033
I am addicted to smoking	1.07 (0.65-1.77); p=0.791	1.13 (0.62-2.08); p=0.687
Heaviness of Smoking Index (per point increase)	0.92 (0.78-1.09); p=0.358	0.93 (0.77-1.13); p=0.464
I am confident I could stop if I tried	2.34 (1.40-3.94); p<0.001	1.81 (1.00-3.29); p=0.050
I am worried that smoking is harming my health right now	1.37 (0.80-2.36); p=0.257	0.89 (0.46-1.74); p=0.730
I am worried that smoking will harm my health in the future	1.53 (0.93-2.52); p=0.096	1.43 (0.78-2.63); p=0.248
I am worried about the effect of smoking on family and loved ones	2.62 (1.57-4.39); p<0.001	2.42 (1.34-4.36); p=0.003
Smoking is costing me too much money	1.14 (0.70-1.86); p=0.609	1.16 (0.65-1.92); p=0.694
Age (increase in 10 years of age)	0.82 (0.50-1.35); p=0.436	0.71 (0.41-1.21); p=0.705
C2DE social grade	0.93 (0.54-1.59); p=0.778	0.84 (0.47-1.51); p=0.561

[a] Adjusted for all other variables.

4.5. Discussion

A minority of smokers had a positive smoker identity in a representative sample of adults (age 16 and over) and in childbearing age women (age 16-34) in England. In each sample, having a positive smoker identity, as measured by agreement with the statement 'I like being a smoker', was associated with being older, reporting enjoyment of smoking, stronger nicotine dependence and lower motivation to stop smoking. In the general population, males and those reporting addiction to smoking and no quit attempts in the past year were more likely to have a positive smoker identity, but there was no significant association with social grade. Positive smoker identity predicted failure to make a quit attempt by the six months follow-up in the general population above all other key predictors of quit attempts. Its association with quit success was similar in magnitude and was also in the negative direction, but failed to reach statistical significance. As expected, quit success was associated with lower nicotine dependence.

In line with previous work involving a somewhat different measure (Jarvis et al., 2002), findings from this study showed that the majority of smokers, especially young women, did not like being a smoker. While the reasons for this were not explored in this study, it is consistent with the hypothesis that with increasing social stigmatization and unacceptability of smoking, smokers become more likely to experience negative feelings about being a smoker (Ritchie et al., 2010, Thompson et al., 2009) and do not want to identify themselves with this self-label (Thompson et al., 2009, Hoek et al., 2013b, Brown et al., 2011, Choi et al., 2010, Ridner et al., 2010, Berg et al., 2009, Levinson et al., 2007).

Characteristics of those with a positive smoker identity are consistent with some aspects of what has been called a 'hardcore smoker' - defined by having no history of abstinence in the past five years and no attempt to quit in the past year as well as having no motivation and no intention to stop smoking in the future (Jarvis et al., 2003). However, as opposed to hardcore smoking (Jarvis et al., 2003), social grade was not associated with liking being a smoker in this study, which is in line with other findings from the literature (Fidler and West, 2009). A possible explanation for the association between age, nicotine dependence and a positive smoker identity is that older smokers might have a longer smoking history and established nicotine dependence; therefore, smoking becomes a firmly entrenched part of their identity. Alternatively, they might report positive feelings about being a smoker to reduce their cognitive dissonance between their attitudes and their smoking behaviour (Festinger, 1957).

A set of factors were examined prospectively that could potentially link with quit attempts and quit success. As discussed in Chapter 2.2.1. and 2.2.2., PRIME theory proposes that having a smoker or a non-smoker identity plays an important role in maintaining or stopping smoking (West, 2006b, West and Brown, 2013). In line with this and with previous studies of smoker identity (van den Putte et al., 2009) and self-perceived motivational factors for continuing smoking (Fidler and West, 2009), this analysis revealed that in the general population positive smoker identity was an important barrier to making a quit attempt in the future. Findings from this study are congruent with the literature (Vangeli et al., 2011, McEwen et al., 2008), as enjoyment of smoking, less confidence in the ability to stop smoking and no worries about future health were all found to be significant barriers to future attempts to stop smoking both in the general population and in childbearing age women.

Understanding the potential barriers to quit attempts is important since smokers generally try many times before stopping permanently (John et al., 2004). This study was the first to examine positive smoker identity and its role in quit attempts and quit success in a representative sample of adult smokers in any country and the findings reported could help to improve interventions and inform communication campaigns to promote smoking cessation. The complexity of identity calls for both qualitative and quantitative studies in the future to better understand its nature, components, operation and best practice for its measurement. It needs to be explored if the associations between a positive smoker identity and quit attempts and quit success hold in special populations, such as pregnant smokers, and further research is needed to examine how, under which conditions and to what extent people internalize a smoker identity and what factors can contribute to an identity change during smoking cessation.

4.5.1. Limitations

This study had several limitations. First, assessment of smoking abstinence did not involve biochemical verification; however, large-scale population-based studies tend to show low levels of bias in self-reporting of smoking status (Benowitz et al., 2002), and there were no particular reasons in this study why participants would not have disclosed their true smoking status. Secondly, a single 'yes or no' question was used as an indication of whether a smoker had a positive smoker identity or not. Thus this measure will not capture the complexity and richness of this construct. However, there is no established and validated smoker identity measure available at the moment and despite this it was highly predictive of quitting. Thirdly, there was a low follow-up rate at six months and the follow-up sample was not selected on

the basis of representativeness for the general adult population in England. However, the differences between those who were followed up and who were not followed up in demographic and smoking characteristics were small in absolute terms with observed statistically significant differences primarily due to the large sample size. Finally, past quit attempts might be forgotten especially if they were unsuccessful or lasted for a shorter period of time or occurred longer ago (Berg et al., 2010a). However, there is no *a priori* reason to assume that the rate of forgetting should differ as a function of smoker identity.

CHAPTER 5 – NON-SMOKER IDENTITY FOLLOWING QUITTING AND ITS ROLE IN LONG-TERM ABSTINENCE (STUDY 2)

5.1. Abstract

'Self-labels' are important aspects of identity that can have a fundamental influence on behaviour. This study assessed the prospective associations between taking on a non-smoker identity following quitting and long-term abstinence. A representative sample of 574 ex-smokers in England (age 16 and over) who quit smoking in the past year was followed up at three months (n=179) and six months (n=163). At baseline, data were analysed separately in a subsample of childbearing age women (n=129). Post-quit identity relating to smoking ('I still think of myself as a smoker' or 'I think of myself as a non-smoker'), demographic and smoking-related characteristics, and self-reported smoking status were assessed. Of recent ex-smokers, 80.3% in the general population and 86.2% in the subsample of young women reported a non-smoker identity. In the overall sample, younger age and longer abstinence were independently associated with a post-quit non-smoker identity. After adjusting for covariates, non-smoker identity and length of abstinence at baseline predicted continued abstinence at three months follow-up, and baseline length of abstinence predicted continued abstinence at six months. This study concludes that the majority of people who quit smoking recently consider themselves as non-smokers. Younger people and those who have been abstinent for longer are more likely to take on a non-smoker identity. Ex-smokers who make this mental transition following a quit attempt appear more likely to remain abstinent in the medium term than those who still think of themselves as smokers.

5.1.1. Dissemination

A version of this chapter has been published in *Addictive Behaviors* (reported in Appendix B-2). Details of this publication are as follows.

Tombor, I., Shahab, L., Brown, J., Notley, C., West, R. (2015). Does non-smoker identity following quitting predict long-term abstinence? Evidence from a population survey in England. *Addictive Behaviors, 45,* 99-103. Doi: 10.1016/j.addbeh.2015.01.026

5.2. Introduction

Generally, the proportion of ex-smokers who remain abstinent permanently is very low (West, 2006a), and the relapse rate can be particularly high after quitting during pregnancy, as approximately 80% of women relapse at six months postpartum (Fang et al., 2004, Krstev et al., 2012). Some forms of pharmacological treatments can be effective in preventing relapse (Agboola et al., 2010, Hajek et al., 2009), but systematic reviews have consistently found insufficient evidence of the effectiveness of behavioural relapse prevention interventions (Agboola et al., 2010, Hajek et al., 2009). To improve behavioural approaches that aim to help people sustain their initially successful quit attempts, we need to advance knowledge of factors that can contribute to long-term behaviour change. A firmly established non-smoker identity has been proposed as one such pivotal factor; yet, there has been little published research on the role it can play in relapse or maintained abstinence in recent ex-smokers.

Approximately 75% of aided quit attempts (Ferguson et al., 2005) and 95% of unaided quit attempts fail within a year (Hughes et al., 2004) with relapse being highest early on, typically in the first few weeks of abstinence (Hughes et al., 2004). Although the risk of relapse decreases sharply over time, it can remain substantial even after years of abstinence (Hughes et al., 2008, Yudkin et al., 2003, Hawkins et al., 2010). The process of relapse starts with an initial lapse that involves a momentary suspension of inhibition to act on impulses to smoke triggered by external or internal stimuli (West and Brown, 2013, West, 2006b), such as the availability of cigarettes (Minami et al., 2014) and negative mood (Vangeli et al., 2010b), which can progress to complete relapse (Shiffman et al., 2006). Therefore, sustained behaviour change requires self-control, for which identity may provide a potentially powerful motivational source (West and Brown, 2013, West, 2006b), so that people inhibit impulses to smoke and govern behaviour in accordance with the desire not to smoke.

As discussed in Chapter 2.2., important aspects of identity are 'self-labels' that describe the categories to which people consider that they belong (e.g. thinking of oneself as a smoker or non-smoker), and 'personal rules' that people set for themselves to specify a range of behaviours that they do or do not do as per their valued identity aspects (West and Brown, 2013, West, 2006b). People are motivated to act in accordance with these identities, and if triggered by the context, salient identities can evoke identity congruent cognitions and behaviour (Oyserman et al., 2007, Oyserman and Destin, 2010). In the context of smoking cessation, making a deep identity change from being a smoker to a non-smoker after a quit attempt is more likely to prompt the formation of strong personal non-smoking rules and generate motives to adhere to this rule in any relevant moment when opposing motives arise (West and Brown, 2013, Lei Hum et al., 2013, West, 2006b).

Only a few studies have been published specifically about ex-smokers' identities following quitting. It has been reported that most people make the mental transition from 'being a smoker' to 'being a non-smoker' following quitting (Vangeli and West, 2012, Vangeli et al., 2010a, Johnson et al., 2003). Nevertheless, a study found that approximately a fifth of people who quit smoking more than two years ago still identified themselves either with 'reluctant non-smoker' or 'smoker who is not smoking' self-labels, and those who had been smoking for longer prior to their most recent quit attempt were more likely to retain a smoker identity despite stopping (Vangeli et al., 2010a). Both qualitative and quantitative evidence have suggested that failing to identify oneself with a firm non-smoker identity following quitting is associated with ex-smokers being vulnerable to future relapse (Johnson et al., 2003, Vangeli et al., 2010a), such as during postpartum (Nichter et al., 2008, Bottorff et al., 2000).

5.2.1. Aims and research questions

Overall, research suggests that a non-smoker identity could provide a basis for effective self-control to prevent ex-smokers from acting on impulses and motivational forces to smoke, but no study has examined this in a representative sample. Therefore, this study aimed to assess the prospective predictive associations between taking on a non-smoker identity following a quit attempt and long-term abstinence in people who quit smoking in the past year. The following research questions were addressed in the general adult population and in a subsample of childbearing age women, where data were available:

1. What is the proportion of recent ex-smokers in a nationally representative sample who report a non-smoker identity?

2. What demographic and smoking-related characteristics are associated with having a post-quit non-smoker identity?
3. What is the predictive relationship between post-quit non-smoker identity for smoking abstinence at three months and six months follow-ups?

5.3. Methods

5.3.1. Study design

This study used data that were collected in the Smoking Toolkit Study (www.smokinginengland.info) (Fidler et al., 2011). A detailed description of the survey methodology, including the sampling technique used and the ethical approval obtained, is reported in Chapter 4.3.1. Between April 2007 and February 2009, when measures used in this study were included in the Smoking Toolkit Study, all smokers and recent ex-smokers who quit in the past year were asked to provide consent to be re-contacted, and those who agreed then received postal follow-up questionnaires at three months from baseline, and again at six months if they returned the first.

5.3.2. Participants

The baseline sample comprised a representative sample of adult (age 16 and over) recent ex-smokers (n=574) who reported having stopped smoking completely in the last year and provided data for all variables included in the current study. Consistent with Study 1 in this thesis (Chapter 4.3.2.), a subsample of childbearing age women (age 16-34) (n=129) was

separated out for analysis. In total, 179 (31.2%) and 163 (28.4%) ex-smokers completed the three months and six months follow-up questionnaires, respectively. Given that only a few childbearing age women were in the follow-up samples (n=36 and n=27 at three months and six months, respectively), prospective associations were not assessed separately in this subsample.

5.3.3. Measures

Data on participants' demographic characteristics (gender, age and social grade) were collected. Social grade was measured according to the British National Readership Survey classification system and dichotomised into ABC1 (those with higher and intermediate professional/managerial, supervisory, clerical, junior managerial/administrative/professional occupations) and C2DE (those with skilled, semi-skilled and unskilled manual, and lowest grade occupations, or unemployed).

Post-quit identity relating to smoking was assessed by asking participants about the categorical self-labels applied to themselves: 'Which one of the following best describes you?' – 'I still think of myself as a smoker' or 'I think of myself as a non-smoker'.

At baseline, data on the numbers of cigarettes per day ('How many cigarettes per day did you usually smoke?') and serious quit attempts in the past year were collected ('How many serious quit attempts to stop smoking have you made in the last 12 months? By serious attempt I mean you decided that you would try to make sure you never smoked again. Please include any attempt that you are currently making'). To assess length of abstinence,

participants were asked: 'How long ago did your most recent serious quit attempt start? By most recent, we mean the last time you tried to quit' ('In the last week'; 'More than a week and up to a month'; 'More than 1 month and up to 2 months'; 'More than 2 months and up to 3 months'; 'More than 3 months and up to 6 months'; 'More than 6 months and up to a year'). They were then further asked about the support they used in their most recent quit attempt ('Which, if any, of the following did you try to help you stop smoking during the most recent serious quit attempt?' – 'Nicotine replacement product (e.g. patches/gum/inhaler) without a prescription'; 'Nicotine replacement product on prescription or given to you by a health professional'; 'Zyban (bupropion)'; 'Champix (varenicline)'; 'Attended an NHS Stop Smoking Service group'; 'Attended an NHS Stop Smoking Service one to one counselling session'). These were dichotomised into 'unaided' (did not use any quit aids) and 'supported' (used any of these listed quit aids) quit attempts in the analysis.

At three months and six months follow-ups, participants were asked whether they smoke cigarettes (including hand-rolled cigarettes) at all nowadays ('Yes' or 'No').

5.3.4. Analysis

Prevalence of a non-smoker identity following a quit attempt was calculated by using weighted data to match English census data on age, gender and social grade. Correlation coefficients were calculated to show the simple association between predictor variables in the logistic regressions. To compare baseline characteristics of those who completed the follow-up questionnaires and those who were not followed up at three months and six months, Pearson's χ^2 and t-tests were used for categorical and continuous variables, respectively.

Univariable logistic regression analyses were performed to assess the cross-sectional associations between baseline demographic and smoking-related characteristics and a post-quit non-smoker identity, and multivariable logistic regression analysis was used to assess the independent association of baseline characteristics with having a non-smoker identity. Similarly, univariable and multivariable logistic regression analyses were conducted to assess the predictive relationship between post-quit non-smoker identity at baseline for smoking status at three months and six months follow-ups, with and without adjusting for other covariates.

5.3.5. Contributions

I conducted the literature search, analysed the data, and wrote up the study. Robert West designed the Smoking Toolkit Study, conceived the initial idea of this study and revised the write up of the study. Lion Shahab, Jamie Brown and Caitlin Notley contributed to the write up of the study.

5.4. Results

5.4.1. Prevalence of a non-smoker identity in recent ex-smokers

In a representative sample of adult recent ex-smokers, 80.3% (95% CI=76.8-83.4) reported a non-smoker identity following stopping smoking completely in the past year; 82.0% (95% CI=77.4-86.6) of men and 78.8% (95% CI=74.2-83.5) of women. The prevalence of a post-quit non-smoker identity varied between 69.0% and 90.9% in different age groups, with

prevalence being 90.9% (95% CI=85.5-96.3) in the youngest (age 16-24) and 76.6% (95% CI=64.5-88.7) in the oldest age group (age 65 and over), and it ranged from 78.5% (95% CI=64.5-88.7) in low socioeconomic groups to 82.1% (95% CI=64.5-88.7) in high socioeconomic groups.

Among childbearing age women, 86.2% (95% CI=80.3-92.1) reported a post-quit non-smoker identity. The prevalence was 91.7% (95% CI=84.7-98.7) in women age 16-24 and 81.4% (95% CI=72.3-90.5) in age 25-34. In terms of socioeconomic groups, 79.0% (95% CI=68.9-89.1) of women from low socioeconomic groups reported a non-smoker identity following quitting, and 92.6% (95% CI=86.4-98.8) of those from higher socioeconomic groups.

5.4.2. Cross-sectional analyses at baseline

Table 7 reports the correlation coefficients between all predictor variables in the logistic regressions. Results are shown for the general population only. Variables did not correlate highly with each other indicating that multicollinearity would not introduce bias in the multivariable regression analyses.

Table 8 shows participants' characteristics in the general population and in the subsample of childbearing age women. Table 9 reports that in the univariable regression analyses, being younger, having been abstinent for longer and having quit unaided were significantly associated with reporting a non-smoker identity following quitting in the general population. After adjusting for all study variables, younger age and increased length of abstinence were

associated with a non-smoker identity.

Table 10 reports the cross sectional logistic regression analyses in childbearing age women. In the univariable analyses, higher social grade, fewer cigarettes per day and increased length of abstinence were significantly associated with reporting a non-smoker identity following quitting smoking in the past year, but none remained significant in the multivariable analysis.

Table 7: Correlation coefficients between predictive variables in logistic regressions calculated in the general population at baseline in Study 2 (n=574)

	1.	2.	3.	4.	5.	6.	7.
1. Non-smoker identity	1						
2. Unaided quit attempt	0.12*	1					
3. Baseline length of abstinence	0.19*	0.06	1				
4. Number of quit attempts in past year	-0.07	0.004	-0.21*	1			
5. Number of cigarettes per day	-0.06	-0.30*	-0.05	-0.06	1		
6. Age	-0.11*	-0.20*	0.03	-0.04	0.25*	1	
7. Gender	-0.43	-0.07	0.03	0.02	-0.09*	-0.04	1
8. Social grade	-0.04	-0.03	-0.07	0.03	0.10*	0.11*	0.03

*p<0.05; Note: where one or more of the variables is dichotomous the correlations are point-biserial and where both are they are tetrachoric.

Table 8: Sample characteristics in the general population and in childbearing age women (age 16-34) at baseline in Study 2

	General population			Childbearing age women		
	Total (n=574)	Post-quit non-smoker identity (n=465)	Post-quit smoker identity (n=109)	Total (n=129)	Post-quit non-smoker identity (n=110)	Post-quit smoker identity (n=19)
Women, % (n)	56.1 (322)	55.1 (256)	60.6 (66)	-	-	-
Age, Mean (SD)	41.5 (16.0)	40.7 (16.2)	45.3 (14.7)	26.0 (4.8)	25.8 (5.0)	27.1 (3.8)
C2DE social grade, % (n)	57.8 (332)	57.0 (265)	61.5 (67)	55.0 (71)	50.9 (56)	78.9 (15)
Number of cigarettes per day, Mean (SD)	14.8 (10.0)	14.5 (9.7)	16.3 (10.9)	11.5 (8.1)	10.7 (7.3)	15.6 (10.6)
Number of quit attempts in the past year at baseline, Mean (SD)	1.4 (0.7)	1.3 (0.7)	1.5 (0.8)	1.4 (0.8)	1.4 (0.8)	1.5 (0.8)
Baseline length of abstinence, % (n)						
Less than a week	6.6 (38)	4.1 (19)	17.4 (19)	5.4 (7)	3.6 (4)	15.8 (3)
1-4 weeks	13.8 (79)	13.1 (61)	16.5 (18)	11.6 (15)	10.0 (11)	21.1 (4)
4-8 weeks	8.4 (48)	8.2 (38)	9.2 (10)	7.8 (10)	7.3 (8)	10.5 (2)
8-12 weeks	9.2 (53)	9.0 (42)	10.1 (11)	14.0 (18)	15.5 (17)	5.3 (1)
12-26 weeks	22.1 (127)	22.6 (105)	20.2 (22)	22.5 (29)	22.7 (25)	21.1 (4)
26-52 weeks	39.9 (229)	43.0 (200)	26.6 (29)	38.8 (50)	40.9 (45)	26.3 (5)
Unaided quit attempt, % (n)	57.8 (332)	60.6 (282)	45.9 (50)	68.2 (88)	69.1 (76)	63.2 (12)

Table 9: Associations between demographic and smoking-related characteristics and a non-smoker identity in the general population at baseline in Study 2

	Non-smoker identity vs. smoker identity at baseline (n=574)	
	OR (95% CI); p-value	Adj. OR[a] (95% CI); p-value
Women	0.80 (0.52-1.22); p=0.299	0.77 (0.49-1.20); p=0.245
Age (increase in 10 years of age)	0.84 (0.73-0.96); p=0.008	0.84 (0.73-0.97); p=0.017
C2DE social grade	0.83 (0.54-1.27); p=0.394	1.00 (0.64-1.56); p=0.982
Number of cigarettes per day (increase in 10 cigarettes per day)	0.84 (0.67-1.05); p=0.132	0.96 (0.75-1.24); p=0.762
Quit attempts in the past year (increase by an attempt)	0.81 (0.62-1.05); p=0.115	0.90 (0.68-1.19); p=0.448
Baseline length of abstinence (increase by duration category)	1.32 (1.17-1.48); p<0.001	1.31 (1.16-1.48); p<0.001
Unaided quit attempt	1.82 (1.20-2.77); p=0.005	1.54 (0.98-2.42); p=0.064

[a] Adjusted for all study variables.

Table 10: Associations between demographic and smoking-related characteristics and a non-smoker identity in childbearing age women (age 16-34) at baseline in Study 2

	Non-smoker identity vs. smoker identity at baseline (n=129)	
	OR (95% CI); p-value	Adj. OR[a] (95% CI); p-value
Age 25-34	0.54 (0.18-1.59); p=0.262	0.53 (0.16-1.75); p=0.298
C2DE social grade	0.28 (0.09-0.89); p=0.031	0.34 (0.10-1.15); p=0.083
Number of cigarettes per day (increase in 10 cigarettes per day)	0.45 (0.22-0.91); p=0.447	0.61 (0.27-1.37); p=0.231
Quit attempts in the past year (increase by an attempt)	0.78 (0.45-1.36); p=0.380	0.81 (0.42-1.56); p=0.532
Baseline length of abstinence (increase by duration category)	1.40 (1.05-1.86); p=0.023	1.28 (0.94-1.75); p=0.123
Unaided quit attempt	1.30 (0.47-3.60); p=0.609	0.93 (0.30-2.91); p=0.902

[a] Adjusted for all study variables.

5.4.3. Prospective analyses at three months and six months follow-ups

Table 11 shows the demographic and smoking characteristics of those in the general population who were followed up and who were lost to follow-up at three months and six months, respectively. Participants who completed the postal questionnaire at three months were slightly older than those who were lost to follow-up. Similarly, participants followed up at six months were older, smoked more before quitting and were less likely to quit unaided.

Results from the prospective logistic regression analyses are reported in Table 12. The univariable analyses showed that males and those who reported a non-smoker identity and had been abstinent for longer at baseline were more likely to be abstinent at three months follow-up. Non-smoker identity and increased length of abstinence remained significant predictors after adjusting for all covariates. At six months, increased length of abstinence was the only significant predictor of smoking abstinence both in the univariable and multivariable logistic regressions. In a sensitivity analyses, predictors of quit success at three months and six months were assessed in separate multivariable regression models with the forward entry method. In terms of quit success at three months follow-up, increased length of abstinence was a significant predictor, and non-smoker identity had a borderline statistical significance ($p=0.053$). The pattern of results remained the same in the sensitivity analysis of six months follow-up.

Table 11: Baseline demographic and smoking characteristics of those who were followed up and who were lost to follow-up at three months and six months in the general population in Study 2

	At three months follow-up		At six months follow-up	
	Lost to follow-up (n=395)	Followed up (n=179)	Lost to follow-up (n=411)	Followed up (n=163)
Women, % (n)	54.4 (215)	59.8 (107)	56.2 (231)	55.8 (91)
Age, Mean (SD)	39.6 (15.8)	45.9 (15.8)*	38.8 (15.4)	48.5 (15.7)*
C2DE social grade, % (n)	58.2 (230)	57.0 (102)	56.7 (233)	60.7 (99)
Number of cigarettes per day, Mean (SD)	14.4 (9.6)	15.8 (10.7)	14.0 (9.2)	17.0 (11.5)*
Number of quit attempts in the past year at baseline, Mean (SD)	1.4 (0.7)	1.3 (0.7)	1.4 (0.7)	1.3 (0.7)
Baseline length of abstinence, % (n)				
Less than a week	7.6 (30)	4.5 (8)	7.5 (31)	4.3 (7)
1-4 weeks	13.4 (53)	14.5 (26)	13.4 (55)	14.7 (24)
4-8 weeks	8.4 (33)	8.4 (15)	7.8 (32)	9.8 (16)
8-12 weeks	10.1 (40)	7.3 (13)	9.7 (40)	8.0 (13)
12-26 weeks	22.3 (88)	21.8 (39)	21.4 (88)	23.9 (39)
26-52 weeks	38.2 (151)	43.6 (78)	40.1 (165)	39.3 (64)
Unaided quit attempt, % (n)	58.5 (231)	56.4 (101)	61.1 (251)	49.7 (81)*
Non-smoker identity, % (n)	80.3 (317)	82.7 (148)	80.5 (331)	82.2 (134)

*Significant differences ($p<0.05$) between the lost to follow-up and followed-up samples at three months and six months, respectively

Table 12: Prospective associations between participants' baseline characteristics and self-reported smoking status at three months and six months follow-ups in the general population in Study 2

	Smoking abstinence vs. relapse at three months follow-up (n=179)		Smoking abstinence vs. relapse at six months follow-up (n=163)	
	OR (95% CI); p-value	Adj. OR[a] (95% CI); p-value	OR (95% CI); p-value	Adj. OR[a] (95% CI); p-value
Non-smoker identity	2.37 (1.07-5.21); p=0.033	2.64 (1.09-6.42); p=0.032	2.19 (0.97-4.97); p=0.060	2.05 (0.83-5.04); p=0.120
Women	0.46 (0.23-0.91); p=0.025	0.49 (0.23-1.05); p=0.067	0.57 (0.29-1.12); p=0.106	0.69 (0.33-1.44); p=0.326
Age (increase in 10 years of age)	1.11 (0.90-1.37); p=0.325	0.99 (0.78-1.26); p=0.930	1.18 (0.94-1.47); p=0.155	1.13 (0.88-1.44); p=0.335
C2DE social grade	0.95 (0.50-1.79); p=0.866	1.10 (0.54-2.26); p=0.791	0.87 (0.44-1.70); p=0.682	0.97 (0.47-2.03); p=0.944
Number of cigarettes per day (increase in 10 cigarettes per day)	1.39 (0.97-2.05); p=0.074	1.22 (0.81-1.85); p=0.338	1.20 (0.86-1.68); p=0.288	1.06 (0.72-1.54); p=0.777
Number of quit attempts in the past year	0.73 (0.49-1.09); p=0.128	1.08 (0.65-1.80); p=0.763	0.81 (0.52-1.25); p=0.343	1.08 (0.63-1.84); p=0.780
Baseline length of abstinence (increase by duration category)	1.58 (1.29-1.93); p<0.001	1.58 (1.26-1.99); p<0.001	1.43 (1.16-1.75); p=0.001	1.41 (1.13-1.76); p=0.003
Unaided quit attempt	0.60 (0.31-1.14); p=0.119	0.54 (0.25-1.18); p=0.123	0.98 (0.51-1.89); p=0.956	0.86 (0.41-1.84); p=0.703

[a] Adjusted for all study variables

5.5. Discussion

In representative samples of adults in the general population and in women of childbearing age in England, the majority – approximately 80% and 86%, respectively – of recent ex-smokers who quit smoking in the past year endorsed the statement 'I think of myself as a non-smoker'. Younger age and increased length of abstinence were important contributors to a post-quit non-smoker identity, and taking on this identity following a quit attempt predicted smoking abstinence in the medium-term in the general population over and above other predictors, including baseline length of abstinence.

Prevalence estimates for the proportion of recent ex-smokers who used the 'non-smoker' self-label to describe themselves were considerably higher in this study than previously found in a non-representative sample of treatment-seeking ex-smokers, in which 46.9% of participants thought of themselves as a non-smoker after quitting in the past year (Vangeli et al., 2010a). However, it is difficult to compare these findings due to the difference between the samples involved. In agreement with the current study, it was previously found that increased length of abstinence was significantly associated with the establishment of a non-smoker identity following quitting (Vangeli et al., 2010a). Consistent with Study 1 in this thesis (Chapter 4.4.), which showed that younger people were more likely to feel bad about their 'smoker' self-label than older people, this study found evidence that younger people were more willing to take on a non-smoker identity after a quit attempt.

In terms of prospective predictors of long-term quit outcomes, previous studies have consistently found that baseline length of abstinence is an important independent predictor of

relapse (Wetter et al., 2004, Hawkins et al., 2010). In line with these findings, this study found that those who had been abstinent for longer at baseline were less likely to report relapse at three months and six months follow-ups. Consistent with relevant theories discussed in Chapter 2.2.2. (Oyserman et al., 2007, West and Brown, 2013, Kearney and O'Sullivan, 2003, Vignoles, 2011, West, 2006b), this study showed that identifying oneself with a 'non-smoker' self-label could contribute to long-term behaviour change; however, the potentially protective influence of a post-quit non-smoker identity to avoid relapse was found to be limited to the initial period after quitting. A plausible explanation for this could be that failing to establish a firm non-smoker identity, with positive feelings attached to it and a strong desire to become someone for whom smoking is not an option, may reflect underlying conflicts about stopping smoking (Wee et al., 2011), and this could deter people from sticking to an absolute non-smoking rule. For example, studies of pregnant smokers have found that even though women report motivation to stop smoking for the sake of the baby, many of them consider cessation as temporary, because they may not want to become a non-smoker (Nichter et al., 2007, Flemming et al., 2013).

Improving the effectiveness of behavioural treatments for relapse prevention would have huge public health benefits, and it could be particularly important for people, such as pregnant women, who cannot or do not want to use pharmacotherapy to support their quit attempts. This study cannot establish how far the label per se or factors that may lead to that label influence relapse risk. This is something that will not be easy to disentangle and will probably require an experimental study. However, this study provides at least a *prima facie* case that the label and its cognitive and emotional associations may play a role. Therefore, findings from this study suggest that harnessing identity change (towards a non-smoker

identity) as part of behavioural smoking cessation support might improve the lasting success of quit attempts, and future research should explore the set of BCTs that can be effective to help people achieve this by incorporating a non-smoker self-label into a core part of their identity. In addition, further research is needed to replicate these findings in larger samples to assess if the prospective relationship between post-quit non-smoker identity and quit success can be found beyond a medium-term follow-up, and to explore if the pattern of results holds in special populations. We also need to better understand the contributing factors to a non-smoker identity following quitting smoking, and explore potential moderator and mediator effects between smoker identity and other predictors of relapse, such as urges to smoke (Herd et al., 2009).

5.5.1. Limitations

One limitation of this study was that assessment of smoking abstinence was based on self-report; however, it was a large-scale population-based study with a relatively low risk of bias in reporting of smoking status (Benowitz et al., 2002). Moreover, due to the small sample size, especially at follow-ups, the study was not designed to assess continued abstinence, and although follow-up rates were relatively low, 'missingness' was not related to identity. In addition, the follow-up sample was not selected on the basis of representativeness for the general adult population in England; however, the differences between those who were followed up and who were not followed up in baseline characteristics were small in absolute terms. There is a lack of reliable measures of nicotine dependence retrospectively, as for example the utility to predict a relapse based on the commonly used HSI (Heatherton et al., 1989) and its two components (cigarettes per day and time to first cigarette) declines rapidly

from around the first month of a quit attempt (Yong et al., 2014). Therefore, it cannot be ruled out that participants' nicotine dependence prior to their most recent quit attempt was not accounted for sufficiently in the analysis. Even though using 'cigarettes per day' might not have been as good as other measures of nicotine dependence, such as urges to smoke (Fidler et al., 2010), it was chosen because urges to smoke might partially mediate the association between identity and relapse, and this study did not aim to assess potential mediation effects. The measure used to assess identity might not have captured the potential richness of people's identities in relation to smoking after a quit attempt; however, this study aimed to focus solely on the two major end-points of potential post-quit identities (i.e. smoker or non-smoker) to evaluate whether it merits further study. Finally, the extent to which participants' identification with categorical self-labels might have changed during the follow-ups was not assessed; therefore, the potential influence of subsequent changes in ex-smokers' identities over time on smoking abstinence could not be evaluated.

CHAPTER 6 – A META-ETHNOGRAPHY OF SMOKER IDENTITY AND ITS ROLE IN SMOKING BEHAVIOUR (STUDY 3)

6.1. Abstract

'Identity' can alter health behaviours and it may be an important target for smoking cessation interventions. This study synthesized findings from qualitative studies on smoker identity and its influences on smoking and cessation. A systematic search of electronic databases was conducted. Qualitative studies on smoker identity in smokers and ex-smokers aged 16-34 were identified in 17 papers. Key concepts were extracted from individual studies and synthesized into higher-order interpretations by following the principles of meta-ethnography. Identified highest-order interpretations were: 1) contributory factors to identity; 2) identity in relation to smoking; 3) contextual and temporal patterning; and 4) behaviour in relation to smoking. Contributory factors included the desire to establish aspirational individual and social identities, enact a smoker identity appropriate to the momentary social context, and alter personal non-smoking rules when consuming alcohol. Smoker identity was multifaceted and incorporated individuals' defensive rationalizations, and both positive and negative feelings attached to it. Smoker identities took time to develop, were subject to change, and were context dependent. Identity was found to play a role in quit attempts. This study concludes that qualitative research into the smoker identity of young adults has established it as a multifaceted phenomenon serving important functions but also involving conflict and defensive rationalizations. It develops over time and contextual factors influence its expression. The nature of a smoker's identity can play an important role in cessation.

6.1.1. Dissemination

A version of this chapter is currently in press in *Health Psychology* (reported in Appendix C-3). Details of this publication are as follows.

Tombor, I., Shahab, A., Herbec, A., Neale, J., Michie, S., West, R. (in press). Smoker identity and its potential role in young adults' smoking behaviour: a meta-ethnography. *Health Psychology.* Published Online: 26 January 2015, Doi: 10.1037/hea0000191

6.2. Introduction

As detailed in Chapter 1.2., stopping smoking especially before middle age has enormous health benefits since it reduces the risks of premature mortality and morbidity caused by smoking-attributable diseases (Doll et al., 2004, Jha et al., 2006, Pirie et al., 2013, Sakata et al., 2012, Strandberg et al., 2008). Given that people commonly start childbearing between their early twenties and mid-thirties (Office for National Statistics, 2014b), quitting whilst young is very important in terms of reducing the risks of maternal and paternal smoking during pregnancy and postpartum (U.S. Department of Health and Human Services, 2006, U.S. Department of Health and Human Services, 2014). However, as 75% of ever smokers in England do not manage to quit by their mid-thirties (West and Brown, 2012), there is a need to improve smoking cessation efforts in younger people. This will require a greater understanding of influences and motivations in relation to smoking and cessation behaviours, and identity has been argued to be one such important factor (discussed in Chapter 2.2.2.).

Quantitative studies have reported various lines of research in relation to smoker identity. First, it has been shown that smokers do not necessarily internalize a 'smoker identity', instead they deny being a smoker (Choi et al., 2010, Ridner et al., 2010, Levinson et al., 2007, Berg et al., 2009, Leas et al., 2014) or identify themselves with alternative self-labels, such as 'social smoker' (Song and Ling, 2011). In addition, people's self-concepts relating to smoking might also change to 'abstainer' self-concept during behavioural support for smoking cessation (Shadel et al., 1996). Secondly, those with a 'smoker' or 'social smoker' identity are less likely to intend to quit smoking (Falomir and Invernizzi, 1999, Hoie et al., 2010, Moan and Rise, 2005, Song and Ling, 2011, van den Putte et al., 2009), more likely to increase the frequency of smoking (Hertel et al., 2012) and more likely to respond defensively to persuasive anti-tobacco messages (Freeman et al., 2001, Falomir and Invernizzi, 1999). Smokers with greater identity and attitudinal conflicts about quitting are more likely to prefer gradual cessation to abrupt cessation (Wee et al., 2011). Thirdly, using the behaviour change technique of strengthening ex-smoker identity can improve self-reported and CO-verified four-week quit rates (West et al., 2010). Beyond these, two population-based studies in this thesis (Studies 1 and 2 reported in Chapters 4 and 5, respectively) have shown that smoker identity can undermine people's efforts to make a quit attempt and to maintain abstinence.

Complementing quantitative evidence, qualitative studies can contribute greatly to develop conceptual understanding of smoker identity by offering potentially deep insights into the meanings people attach to their smoker identities and how changes in these could shape their smoking and smoking cessation behaviour. Synthesizing qualitative findings in a systematic way has begun to be widely applied in recent years to advance knowledge across the medical

and social sciences (Smith et al., 2005, Malpass et al., 2009, Hubbard et al., 2011, Ring et al., 2011), for which meta-ethnography has been deemed an effective method (Campbell et al., 2011, Toye et al., 2014). The meta-ethnographic method of synthesis was developed in order to enable researchers to accumulate evidence from qualitative studies, as an analogue to a quantitative meta-analysis, and provide insights into research topics (Noblit and Hare, 1988). This can be achieved by translating key concepts across original qualitative studies, and developing a single comprehensive framework, so extending understanding beyond that offered via individual qualitative studies (Noblit and Hare, 1988).

6.2.1. Aims and research questions

Overall, theories and empirical evidence in this field have begun to establish identity as an important influence on smoking behaviour, and qualitative studies can provide further insights into how this influence might manifest. Therefore, this study aimed to improve understanding of smoker identity and its role in smoking cessation by undertaking a systematic literature review of the available qualitative evidence on smoker identity of young adults, and use the meta-ethnographic method of synthesis to provide insights. The following research questions were addressed in the meta-ethnography:

1. How do smokers perceive their smoker identity, and what factors shape their beliefs, meanings and attitudes attached to it?
2. How does identity change preceding or following smoking cessation?
3. How does smoker identity influence smoking and smoking cessation?

6.3. Methods

6.3.1. Search strategy

Electronic databases (PubMed/MEDLINE, PsychInfo, Web of Knowledge and CINAHL Plus) were searched from the inception of each database to 19th September 2013 by using the terms: ((identit* OR self-concept OR self-identit* OR self-labe*) AND (smoker OR smoking OR tobacco use) AND (adolescen* OR youn* OR teenage* OR studen* OR pregnan*)). Searches for MeSH terms were added where applicable to the database. The search was restricted to journal articles published in English, and grey literature was excluded. Records were downloaded into EndNote and duplicates removed. To identify further relevant articles, corresponding authors of the included papers were contacted, and reference lists of the included papers were hand-searched.

6.3.2. Exclusion and inclusion criteria

To define inclusion criteria for papers in the meta-ethnography, the PICo (Population, phenomena of Interest, Context) framework for qualitative studies was applied, which is an adaptation of the widely used PICOTS (Population, Intervention, Comparison, Outcome, Time-frame, Study design) framework (The Joanna Briggs Institute, 2011). According to PICo, papers were eligible for inclusion if: 1) the study population comprised young adults (age 16-34) who were current smokers or ex-smokers at the time of enrolment; 2) the phenomenon of interest in the paper was 'identity' defined as participants' thoughts, images and/or feelings about themselves; 3) the context in which the phenomenon was considered

was cigarette smoking; and 4) the papers were original qualitative research articles that were published in peer-reviewed journals and written in English. Reviews, book chapters, dissertations, commentaries and protocol papers were excluded.

Papers were screened against the inclusion criteria by two researchers independently starting with titles and abstracts (n=1,694) and then moving on to the full-text screening of the papers (n=123). After all titles and abstracts were screened, the initial inter-rater agreement was acceptable (Cohen's κ=0.61). Discrepancies were discussed and, if needed, resolved by Lion Shahab. From all full-text articles screened, 17 met the inclusion criteria.

6.3.3. Quality assessment

The quality of the 17 included papers was assessed by two researchers independently using the National Institute for Health and Clinical Excellence (NICE) quality appraisal checklist for qualitative studies (NICE, 2012). Depending on the number of criteria fulfilled (min=0; maximum=14), papers were categorized into: high (11-14), medium (7-10) or low (0-6) quality with 82.4% initial inter-rater agreement, and disagreements were resolved through discussion. The overall quality of the papers was found to be good: eight were categorized as high quality, eight as medium quality and one as low quality. Common weaknesses, as judged by the quality appraisal checklist, were: lack of triangulation, inadequate description of the role of the researcher, how the researcher may have influenced the results, and the context of the study. Given the lack of consensus in the literature about the quality appraisal of qualitative papers (Campbell et al., 2011, Toye et al., 2013, Dixon-Woods et al., 2001), the low quality paper was not excluded.

6.3.4. Data extraction

Data on study characteristics (aims, design, setting, target population and sample size) and participants' characteristics (age, gender, ethnicity and smoking status) were extracted by myself and verified by Aleksandra Herbec. Key concepts relating to smoker identity that were identified in the findings of the included papers were extracted by myself with dual data extraction conducted on 50% of eligible studies by Aleksandra Herbec. Inconsistencies were resolved through discussion.

6.3.5. Analysis

Data analysis was conducted by following the principles of meta-ethnography (Noblit and Hare, 1988, Toye et al., 2014). First, included papers were read to identify relevant key concepts in the results section of each study. The extracted key concepts, in which the meaning of the original text was preserved, were then compared with each other and synthesised to generate a list of first-order interpretations. Overarching second-order interpretations were then derived from first-order interpretations expressing similar concepts. The final level of synthesis involved the development of a comprehensive framework by establishing the relationship between second-order interpretations to form third-order interpretations.

The analysis involved repeated discussions between Robert West, Lion Shahab, Susan Michie, Joanne Neale and myself and several iterations of the framework were produced until agreement was reached. Extracted key concepts were organized in Excel and a paper-based

approach was used for developing second-order and third-order interpretations. Qualitative data analysis software was not used. In the final step, illustrative quotations were selected from relevant papers to represent key concepts relating to the interpretations formulated in the synthesis.

6.3.6. Contributions

I designed and wrote up the protocol for this study, carried out the systematic literature search, screened the papers against inclusion criteria and assessed their quality, extracted and analysed the data, and wrote up the final study. Robert West and Lion Shahab contributed to the design of the study and the interpretation of the data, and they revised the write up of the study. In addition, Lion Shahab assisted in the paper selection. Aleksandra Herbec assisted in the paper selection, quality assessment, data extraction and she contributed to the write up of the study. Joanne Neale and Susan Michie contributed to the interpretation of the data and to the write up of the study.

6.4. Results

6.4.1. Results of the literature search

Figure 7 shows the paper selection process. Of all records identified, 17 qualitative papers reporting on 14 studies, collectively including about 500 smokers from Western industrialised countries, met the inclusion criteria. Multiple papers with the same participants were included, since each paper contributed different findings that broadened understanding

of the study data. The study characteristics of included papers are reported in Table 13, and the list of excluded papers after full-text screening with reasons for exclusion is reported in Appendix C-4.

Figure 7: Flow chart for paper selection in the meta-ethnography

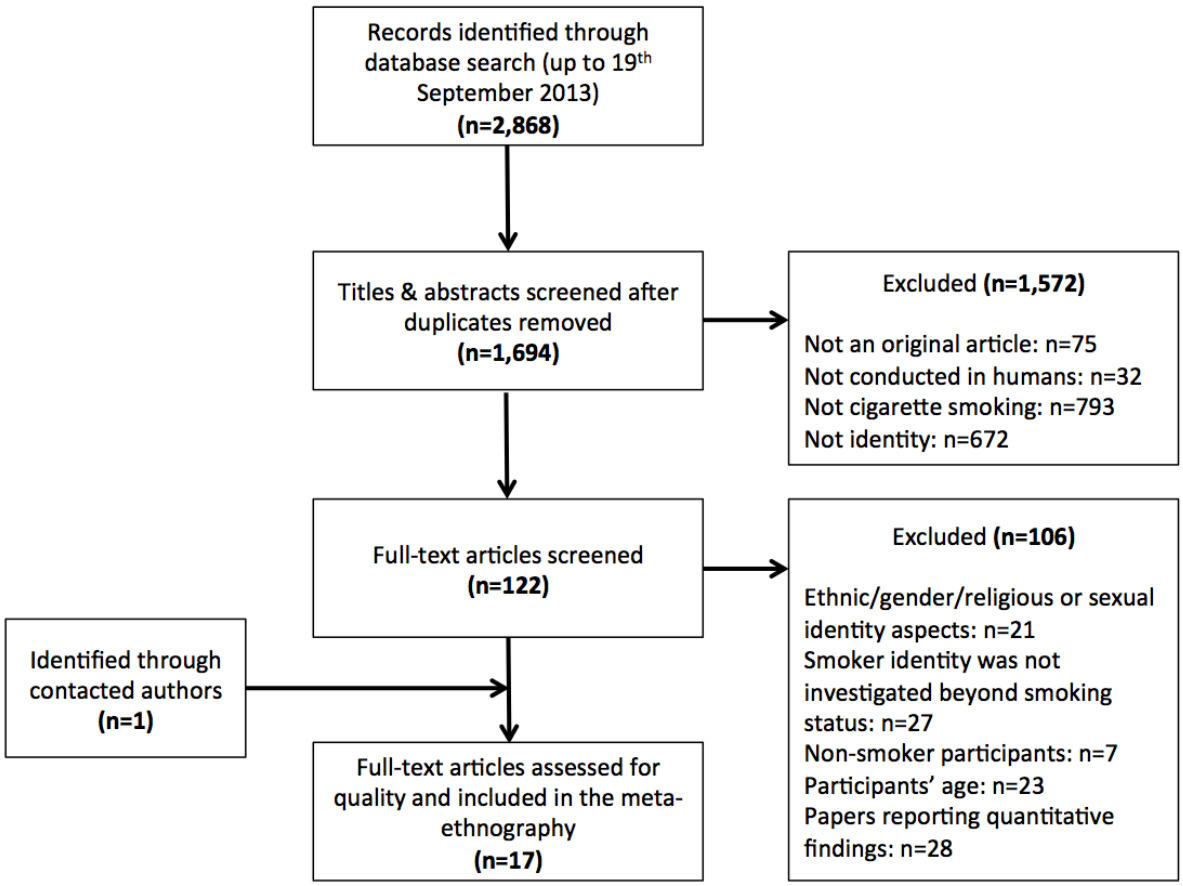


Table 13: Study characteristics of the included papers in the meta-ethnography

Authors	Aims	Design	Setting	Target population	Sample size	Age	Female	Ethnicity	Smoking status
Amos et al., 2006	To explore participants' understanding of their smoking behaviour, and attitudes towards quitting and cessation support.	Interview study	UK	Adolescents	n=99	16-19	52.5%	White Scottish (100%)	Daily (n=75) and occasional smokers (n=24)
Berg et al., 2010	To explore how college students define 'a smoker', what their experiences are with quitting and motives for and barriers to cessation.	Focus group	USA	College and university students	n=73	18-25	56.2%	White (89.0%)	Smoked 25 days or more of past 30 days (n=24)
Brown et al., 2011	To understand the personal motivational forces that influence occasional smoking.	Focus group	USA	University students	n=53	18-25	56.6%	White (50.9%)	Occasional smokers (n=53)
Gilbert, 2007	To explore what cigarette smoking means for young women.	Interview study	Australia	Young women	n=20	18-24	100%	Australian (100%)	Daily smokers (n=20)
Hoek et al., 2013a	To explore how young adult smokers interpret current tobacco warning messages.	Interview study	New Zealand	Young adult smokers	n=17	18-30	47.1%	New Zealander (100%)	Daily (n=9) and social smokers (n=8)
Hoek et al., 2013b	To explore how young adult social smokers view smoking and reconcile their conflicting smoker and non-smoker identities; what factors facilitate or catalyse social smoking; and what interventions would be needed.	Interview study	New Zealand	Young adult social smokers	n=13	19-25	30.8%	New Zealander (76.9%)	Social smokers (n=13)
Johnson et al., 2003	To explore how youth describe their tobacco use.	Interview study	Not reported	Young people	n=35	14-18	51.4%	Not reported	Ever, occasional and daily smokers
Kishchuk et al., 2004	To explore students' views on smoking cessation interventions.	Focus group	Canada	College students	n=69	18-34	43.5%	Not reported	Smokers (69.6%) and ex-smokers (26.1%)
Lawson, 1994	To explore low-income pregnant smokers' views on the perceived benefits of tobacco use and what believes influence cessation of smoking.	Interview study	Not reported	Low-income pregnant adolescents	n=20	16-18	100%	White (70.0%)	Daily smokers (100%)

Authors *(continued)*	**Aims**	**Design**	**Setting**	**Target population**	**Sample size**	**Age**	**Female**	**Ethnicity**	**Smoking status**
Lennon et al., 2005	To explore personal and social factors influencing the likelihood of smoking among young women.	Focus group and interview study	Australia	Young women	Not reported	16-28	100%	Not reported	Smokers: 5 focus groups, 3 interviews; Non-smokers: 6 focus groups, 1 interview; Smokers and non-smokers: 3 focus groups, 2 interviews
MacFadyen et al., 2003	To examine the impact of smoking related imagery in youth magazines on young smokers.	Focus group	UK	College and university students	N.R.	17-18	50%	Not reported	Regular smokers (6 focus groups); Occasional smokers (6 focus groups)
Moffat and Johnson, 2001	To explore the meaning of nicotine addiction for teenage girls in the context of their lives and smoking patterns.	Interview study	N.R.	Adolescents	n=12	14-17	100%	Not reported	Ever smokers
Rooke et al., 2013	To explore young adults' views on the smokefree legislation, and their smoker identity in relation to the negative social climate around smoking and how it affected their social identity.	Interview study	England	Young adult smokers and ex-smokers	n=27	18-29	44.4%	White British (51.9%)	Daily and occasional smokers
Scheffels and Schou, 2007	To explore young smokers' views on continuing to smoke in the context of increasing structural and symbolic pressure to quit, issues of legitimacy, meaning and identity.	Interview study	Norway	Young adult smokers	n=21	18-23	47.6%	Not reported	Daily (n=19) and occasional smokers (n=2)
Scheffels, 2008	To explore young adults' construction of meaning and identity in accounts of cigarette brands and package design.	Interview study	Norway	Young adult smokers	n=21	18-23	47.6%	Not reported	Daily (n=19) and occasional smokers (n=2)
Scheffels, 2009	To explore young adult smokers' experiences with smoking in relation to the construction of identity.	Interview study	Norway	Young adult smokers	n=21	18-23	47.6%	Not reported	Daily (n=19) and occasional smokers (n=2)
Wiltshire et al., 2005	To explore young smokers' experiences and attitudes towards smoking, being a smoker and the role it plays in their lives.	Interview study	Ireland	Young people	n=99	16-19	52.5%	White Scottish (100%)	Daily (n=75) and occasional smokers (n=24)

6.4.2. First-, second-, and third order interpretations

In total, 248 key concepts were identified and synthesised into 143 first-order interpretations. The list of first-order interpretations is reported in Appendix C-5, from which the most frequent was 'identification with a social/casual smoker identity rather than a smoker identity'. First-order interpretations were synthesised into 15 second-order interpretations and subsequently four third-order interpretations: 1) contributory factors to identity, 2) identity in relation to smoking, 3) contextual and temporal patterning and 4) behaviour in relation to smoking. Third-order interpretations with their contributing second-order interpretations are discussed in detail below.

I. Contributory factors to smoker identity (Individual, social and behavioural factors)

1. *Being a smoker serves other personal identity functions*

Internalization of a smoker identity was found to be frequently grounded in individuals' desire to establish aspirational identities, including being a mature, sophisticated, glamorous or self-confident person.

> *"I think when you see those pictures in New Weekly, and there's, like, Elle Macpherson, and she's got a cigarette in her hand, I think it's pretty obvious what people think, because they look up to them as iconic, then they think, well they can do it, I can do it."* (Gilbert, 2007; p.7)

Smoking tended to be seen as an identity trademark that people could use to distinguish themselves from others and to express their individuality, other identity aspects (e.g. identity as a young person) and personal attributes (e.g. being a fun-loving person who prioritises pleasure over health awareness) (Gilbert, 2007, Lennon et al., 2005, MacFadyen et al., 2003, Moffat and Johnson, 2001, Scheffels and Schou, 2007, Scheffels, 2008, Scheffels, 2009, Wiltshire et al., 2005, Rooke et al., 2013).

> *"I play the guitar and when I go with my friends from the band to these music bars, smoking kind of becomes part of that rock n' roll image."* (Scheffels, 2008; p.120)

2. *Being a smoker has social benefits*

It was found that being a smoker could enhance social power, since it helped individuals to feel included, express membership of their social groups and maintain an identity that was valued within these groups. However, smoking was not necessarily experienced as pleasurable; rather, engaging in smoking was essential for social acceptance: the benefits of being part of a group of smokers and establishing a smoker identity appeared to outweigh the risks of smoking (Brown et al., 2011, Hoek et al., 2013b, Johnson et al., 2003, MacFadyen et al., 2003, Scheffels, 2009, Wiltshire et al., 2005, Gilbert, 2007, Lennon et al., 2005, Scheffels, 2008, Scheffels and Schou, 2007, Hoek et al., 2013a).

> *"Like I know it's bad for me but I can just do it and fit in or I can say no and run the risk of being out-casted or something like that."* (Hoek et al., 2013b; p.263)

3. *Social environment influences the enactment of a smoker identity*

Studies found that being a smoker could be considered an acceptable, even desirable, identity around friends and other smokers. However, as the context changes to either a more private or a professional situation (e.g. being around family members, employers or clients), the 'smoker identity' often needed to be hidden.

> *"A really big difference is in the type of image that you give off if you're walking across campus smoking than if you're in a party smoking."* (Brown et al., 2011; p.1202)

Whilst there was evidence that some smokers might strengthen their smoker identification as a counter to the stigma associated with smoking (Brown et al., 2011, Johnson et al., 2003, Hoek et al., 2013b, Wiltshire et al., 2005, Scheffels, 2008, Hoek et al., 2013a, Scheffels, 2009, Rooke et al., 2013), awareness of the negative social discourse associated with smoking frequently resulted in a denial of being a smoker, even in front of strangers, in order to avoid destroying one's reputation and to make a good first impression (cf. II. below).

> *"I don't smoke at work cause I work in a posh, posh shop and don't want clients thinking 'oh there's another wee girl smoking, it looks so silly they think they're so grown up'."* (Wiltshire et al., 2005; p.610)

4. *Other behaviours influence smoker identity*

Being in situations where alcohol was being consumed was repeatedly identified as an important factor overriding personal non-smoking rules, and it appeared to make smoking more acceptable and reduced cognitive dissonance. Additionally, being a 'non-smoker who smokes when drinking' could become part of a smoker's self-definition; thus, maintaining a dual identity as smoker and non-smoker and ultimately reducing identity conflicts.

> *"Well I hate it. [the person strongly identified himself as a non-smoker] Like if someone lit one up right now I'd probably vomit. It just makes me feel so sick. It's weird, I just yeah, well, after I've had a drink I just don't care."* (Hoek et al., 2013b; p.264)

The ban on smoking in indoor spaces prompted smokers to pay closer attention to how they presented their identities when returning to indoor drinking locations after smoking outdoors. Nonetheless, a sociable smoker identity could be maintained with the introduction of beer gardens and other forms of pleasurable outdoor spaces where smoking is permitted (Hoek et al., 2013b, Johnson et al., 2003, Lennon et al., 2005, Wiltshire et al., 2005, Brown et al., 2011, Rooke et al., 2013).

> *"When you are outside talking to people, that's when you meet new people because they are, there are areas where people smoke is really social […] you go outside and everyone automatically starts talking to each other and it's very social."* (Rooke et al., 2013; p.113)

II. Identity in relation to smoking

5. *Smoker identity is multifaceted*

The research found that multiple smoker identities appeared to co-exist with one salient smoker identity at any given moment. The list of different smoker identities identified is reported in Table 14.

> *"I don't see myself as a smoker but I see myself as a social smoker. It's almost like they're almost mutually exclusive."* (Hoek et al., 2013b; p.263)

Smoker identities could be characterized by different dimensions: whether individuals perceived themselves as having an active or a passive role in the development of a given smoker identity, whether they saw the health effects of smoking as personally relevant to them and whether they thought about smoking as an ongoing behaviour (Berg et al., 2010b, Brown et al., 2011, Hoek et al., 2013b, Johnson et al., 2003, Lennon et al., 2005, MacFadyen et al., 2003, Moffat and Johnson, 2001, Scheffels, 2008, Wiltshire et al., 2005, Rooke et al., 2013, Scheffels, 2009).

> *"[Smoking has] very negative health effects, but I don't feel like those really affect me as much [because I am] an occasional smoker."* (Brown et al., 2011; p.1201)

Table 14: List of identified smoker identities in the meta-ethnography

Addicted smoker identity	Non-smoker identity despite smoking
Social/casual smoker identity	Accepting non-smoker identity
Non-daily/occasional smoker identity	Ardent non-smoker identity
Contrite smoker identity	Vulnerable non-smoker identity
Confirmed smoker identity	Confident non-smoker identity
Cool smoker identity	
Performative smoker identity	
Considerate/inconsiderate smoker identity	
In-control smoker identity	
Defensive/negotiating smoker identity	

6. A 'non-smoker' identity is confirmed by defensive rationalizations

Individuals often used forms of defensive rationalization to justify to themselves that they were not 'smokers', despite smoking cigarettes. Such rationalizations focused on the specifics of smoking behaviours, such as they smoked less and less often than others around them or they would never buy cigarettes for themselves, never smoke alone and never deeply inhale tobacco smoke.

> *"If I'm not buying them, I'm not a smoker. If I'm only getting them off people, then it's not an issue. Because I'm not wasting my money."* (Hoek et al., 2013b; p.263)

Smokers reported that they felt in control of their smoking and discussed ease of quitting, even though they might have never tried. Those who denied being a smoker preferred a 'social smoker' self-label, consistently stated that they were not addicted to cigarettes, and

attributed any cravings to the social aspects of smoking (Amos et al., 2006, Berg et al., 2010b, Brown et al., 2011, Hoek et al., 2013b, MacFadyen et al., 2003, Moffat and Johnson, 2001, Scheffels and Schou, 2007, Scheffels, 2009, Wiltshire et al., 2005, Rooke et al., 2013, Johnson et al., 2003).

> *"I could stop just like that. I don't smoke a lot so I would find it easy to quit." [daily smoker who did not consider herself a 'smoker' and never tried to quit].* (Amos et al., 2006; p.184)

7. *Negative images are associated with being a smoker*

Individuals generally associated smoking with negative characteristics relating to physical appearance (e.g. having yellow teeth and smelling), psychological characteristics (e.g. being desperate and anxious) and future aspirations (e.g. not being successful).

> *"I wish I never smoked. It costs money; it's disgusting; it's dirty; it makes your clothes smell bad; it makes your hair smell bad; it makes your teeth ugly; and it just sucks your whole life into it."* (Johnson et al., 2003; p.394)

They also recognized that others might portray them similarly, which evoked feelings of shame and regret. These stereotypical negative smoker characteristics were seen as incompatible with individuals' own self-image; thus smokers wanted to avoid this unattractive identity either by not being seen publicly as a smoker or by stopping smoking

(Berg et al., 2010b, Brown et al., 2011, Johnson et al., 2003, MacFadyen et al., 2003, Scheffels, 2008, Rooke et al., 2013, Scheffels, 2009, Hoek et al., 2013a, Hoek et al., 2013b).

> *"The label that we get is… 'oh, you're smoking', you know, brush away; it's not a big deal to them. But some people, it's just, you know – just say it's kind of like being a teenager: you get the turned-up noses and the bad looks from people because you are a smoker, and, you know, I wish I wasn't a smoker because I'd give those faces to people."* (Johnson et al., 2003; p.391)

8. *Negative images are associated with becoming an addicted smoker*

Addicted smokers were often referred to as 'real smokers' and were portrayed negatively (e.g. they had lost control of smoking and had urges to smoke) by non-daily smokers. Participants, regardless of whether they were daily or non-daily smokers, reported controlling when and how many cigarettes they smoked thereby enabling them to avoid addiction and being looked down on. Fear of becoming addicted appeared to underlie individuals' intentions of dissociating themselves from an addicted smoker self-image and expressing an identity as a 'smoker in control' (Amos et al., 2006, Brown et al., 2011, Hoek et al., 2013b, Johnson et al., 2003, MacFadyen et al., 2003, Moffat and Johnson, 2001, Scheffels, 2008, Scheffels, 2009, Scheffels and Schou, 2007).

> *"I don't want to become addicted to where I have to smoke many a day...that's the only reason I don't smoke as much."* (Brown et al., 2011; p.1201)

9. Being a smoker causes identity conflicts

There were evident discrepancies between having a smoker identity and other current or future identity aspirations, such as being an athlete or a successful person. Likewise, being accepted by an immediate social group of smokers and simultaneously stigmatized by society more generally appeared to create fundamental internal conflicts. Such tension could then trigger a shift between smoker identities, including a complete denial of being a smoker (Brown et al., 2011, Hoek et al., 2013b, Johnson et al., 2003, Moffat and Johnson, 2001, Rooke et al., 2013).

> *"I done work experience a while back and I didn't want him to know I was smoking… I don't know, it's not something you are proud of, the fact that you smoke. Even though I do enjoy it."* (Rooke et al., 2013; p.111)

10. Being a smoker is a positive identity

Studies found that there were smokers with various life-circumstances for whom 'being a smoker' was still a positive identity as they considered their internalized smoker identity to be a 'relatively' better life choice and morally superior to being a drug user or alcoholic. Similarly, being a light smoker or non-daily smoker could be deemed superior to being a 'pack-a-day' smoker or addicted daily smoker. Comparing themselves favourably to others in their immediate social environment thus enabled smokers to retain a relatively positive identity despite the perceived negative connotations of smoking (Johnson et al., 2003, Lawson, 1994, Scheffels, 2009, Brown et al., 2011, Hoek et al., 2013b).

"I'm better than other girls in the projects who are running around with different boys, selling their bodies for drugs, and writing cold checks 'cause I just smoke." (Lawson, 1994; p.68)

III. Contextual and temporal patterning

11. Development of a smoker identity is an evolutionary process

The term 'becoming a smoker' was used to describe individuals' experiences of internalizing a smoker identity. A smoker identity was adopted over time but, once established, seldom consciously questioned. Initiation of a smoker identity was commonly triggered by an unsuccessful quit attempt, buying cigarettes for oneself, and the recognition that smoking was no longer limited to particular times or places (Amos et al., 2006, Berg et al., 2010b, Johnson et al., 2003, Kishchuk et al., 2004, Moffat and Johnson, 2001, Scheffels, 2008, Wiltshire et al., 2005, Scheffels, 2009).

"I never used to think of myself as a smoker, it was just as someone who smoked. One day I couldn't be bothered smoking and I wanted to stop but I couldn't stop. And I didn't even know I was addicted." (Wiltshire et al., 2005; p.608)

12. Possibility for a shift between smoker identities

Individuals were found to be purposefully shifting between their smoker identities and the possibility of rapidly transitioning between these identities enabled smokers to act in different ways in different contexts (e.g. in front of friends vs. employers).

> *"Say you have a big wide wardrobe, and you have certain clothes for certain things. And say you'll have a certain outfit that you'll wear to school, and you have a certain outfit that you will wear to, say, the bar. The cigarette would be the outfit I would wear to the bar, but it's not the outfit I would wear to school."* (Johnson et al., 2003; p.393)

As a result, concurrent smoker identities did not necessarily cause identity conflicts or tension. Long-term changes in smoker identities from being a 'smoker' to a 'non-smoker' could, however, provide individuals with a good basis for maintaining smoking cessation (cf. IV. below) (Johnson et al., 2003, Scheffels, 2008, Scheffels, 2009).

13. Future smoker identities exist

Complementing their current smoker identities, smokers proffered mental representations of themselves as they might be in the future. They suggested future personal situations, in which smoking would not be an option (e.g. they would not smoke if they had a child).

> *"When I see my future I don't see myself as a smoker, I don't see myself even as a social smoker."* (Hoek et al., 2013b; p.263)

On the other hand, those who recognised that smoking was an addiction for them or who had already tried to quit smoking but failed tended not to hold future non-smoker identities. Similarly, individuals who associated being a smoker with other positive identity aspects, such as being an adult, were reluctant to imagine themselves other than as a smoker in the future (Amos et al., 2006, Brown et al., 2011, Hoek et al., 2013b, Johnson et al., 2003).

IV. Behaviour in relation to smoking

14. Smoker identities influence making a quit attempt

Smoker identities appeared to influence individuals' intentions to make a quit attempt. The conflict between smoker identities and other valued identity aspects (e.g. being a good mother) could generate motives to attempt cessation. Conversely, factors that could undermine a desire to quit smoking included having positive feelings about being a smoker, incorporating positive risk acceptance into one's smoker identity, or internalizing a 'non-smoker' identity despite smoking cigarettes. In addition, those with an established smoker identity formulated only vague plans to stop smoking in the future (Amos et al., 2006, Berg et al., 2010b, Brown et al., 2011, Hoek et al., 2013b, Johnson et al., 2003, Kishchuk et al., 2004, Lennon et al., 2005, MacFadyen et al., 2003, Scheffels, 2009, Scheffels and Schou, 2007).

> *"I don't really think about myself as a smoker, so it is hard to think about when you would quit."* (MacFayden et al., p.495)

15. Smoker identities influence long-term abstinence

Having a strong belief about being able to become a non-smoker, and formulating plans to leave a 'smoker self' behind could help individuals to abstain from smoking. Being someone who managed to quit smoking and did not want to smoke ever again could also give strength and feelings of positive self-evaluation (Johnson et al., 2003). Despite this, where smoking cessation was induced by the social environment and was not grounded in an individual's own wants and needs to remain abstinent, the possibility of future smoking remained. Similarly, lack of a firm non-smoker identity appeared to make individuals vulnerable to start smoking again.

> *"You never know, one day something will click and I will smoke."* (Johnson et al., 2003; p.392)

Table 15 reports a summary of the synthesis with examples of key concepts identified in original articles, examples of first-order interpretations, and the list of second- and third-order interpretations, as detailed above.

Table 15: Formulation of first-order, second-order and third-order interpretations in the meta-ethnography

Examples of key concepts identified in original research articles	Examples of first-order interpretations (ID numbers of all related first-order interpretations as reported in the Appendix C-5)	Second-order interpretations	Third-order interpretations
"I think smokers seem so relaxed…and I want to look relaxed." (Scheffels and Schou, 2007; p.171)	Smoking to achieve an ideal self (#19, 23, 25, 37, 38, 39, 41, 42, 43, 48, 61, 99, 102, 103, 121, 134)	1. Being a smoker serves other personal identity functions	I. Contributory factors to identity (Individual, social and behavioural factors)
"Wasn't that interested in it [smoking during school years]. I was just into my PE. But now that's all gone [desirable social status]. I still go for my run, still go to the gym, but with bricklaying everybody else smokes" (Wiltshire et al., 2005; p.611)	Smoking to express an identity, which is in accordance with that is valued by the social group to maintain social status (#40, 44, 51, 59, 62, 67, 101, 104, 105, 137, 140, 141)	2. Being a smoker has social benefits	
"If a complete stranger was to come up to me and ask if I smoked, I would say 'no', just in case they are looking for someone for a job." (Wiltshire et al., 2005; p.611)	Being a smoker is cool with other smokers, but not acceptable in a professional environment (#22, 34, 35, 36, 56, 136, 138)	3. Social environment influences the enactment of a smoker identity	
"[not a smoker] because I don't smoke, right? I don't smoke unless I'm drinking." (Johnson et al., 2003; p.391)	Consuming alcohol liberates smokers from their non-smoker identity and reconcile dissonance that would normally keep them away from smoking (#20, 34, 52, 57, 58, 117, 132, 133)	4. Other behaviours influence smoker identity	
"I define myself as an occasional smoker because I don't really like it, I don't even like the taste of it. I do it whenever I'm under stress because it helps me to organize my thoughts and be alone." (Berg et al., 2010; p.966)	Identification with a non-daily/occasional smoker identity as opposed to a smoker identity (#31, 54, 63, 64, 65, 66, 68, 70, 71, 72, 74, 78, 82, 84, 85, 86, 89, 108, 116, 122, 123, 129)	5. Smoker identity is multifaceted	II. Identity in relation to smoking
"Occasionally I smoke but I wouldn't say I'm a smoker; it's like saying that occasionally I drink versus saying I'm an alcoholic." (Brown et al., 2011; p.1201)	Identifying oneself as a smoker depends on whether the person thinks that he/she is addicted or smokes due to habit (#1, 2, 3, 16, 18, 21, 24, 26, 28, 45, 47, 60, 96, 106, 110, 111, 112, 113, 120)	6. A 'non-smoker' identity is confirmed by defensive rationalization	
"It's not cool smelling like a cigarette all the time and people who don't smoke smell you, they are like, yeah, I don't know, give you a look or something…it's pretty shaming." (Hoek et al., 2013a; p.614)	Do not want to be seen as a smoker due to feelings of guilt and shame associated with it (#27, 29, 49, 75, 130, 131, 135, 139, 142)	7. Negative images are associated with being a smoker	

"How can I be addicted if I don't even buy cigarettes, I just get one from a friend once in a while." (Moffat et al., 2001; p.672)	Rejection of being addicted to maintain identity as a person who keeps smoking under control (#5, 6, 7, 8, 9, 10, 31, 32, 107, 109)	8. Negative images are associated with becoming an addicted smoker	*(continued)*
"Um, it makes it all, you think why did I do this, you know, I don't need to do this, this is ridiculous. But then I just do it again anyway. I dunno. It's ridiculous, it's absolutely ridiculous." (Hoek et al., 2013b; p.264)	Internal conflicts due to perceived superior status as a non-smoker but engaging with stigmatized behaviour (#30, 46, 49, 50, 53, 55, 80, 100, 136)	9. Being a smoker causes identity conflicts	II. Identity in relation to smoking
"I'm proud to be just a smoker 'cause my parents are alcoholics. My dad is drinking himself to death at age 36. My mother drinks beer every day. I only smoke one cigarette three times a day." (Lawson, 1994; p.69)	Being a smoker gives feelings of superiority above other substance users (#90, 91, 92, 107)	10. Being a smoker is a positive identity	
"'I smoke' rather than 'I am a smoker." (Kischuk et al., 2004; p.496) "I don't socially smoke any more, I buy my own, I think that's always a sign when you're a proper smoker, you stop borrowing off other people." (Witshire et al., 2005; p.608) "I'm a regular smoker, not exactly heavy. I'm not a pack-a-day [smoker] yet." (Johnson et al., 2003; p.394)	Smoking is not part of identity Identification with a smoker identity is associated with buying one's own cigarette Acceptance of a 'smoker identity' is unquestioned and it is adopted by time (#13, 74, 88, 95, 97, 98, 115, 118, 119)	11. Development of a smoker identity is an evolutionary process	III. Contextual and temporal patterning
"Say you have a big wide wardrobe, and you have certain clothes for certain things. And say you'll have a certain outfit that you'll wear to school, and you have a certain outfit that you will wear to, say, the bar. The cigarette would be the outfit I would wear to the bar, but it's not the outfit I would wear to school." (Johnson et al., 2003; p.393)	Purposefully shifting their smoker identities context to context (#81, 83, 127, 143)	12. There is a possibility for a shift between smoker identities	
"When I see my future I don't see myself as a smoker, I don't see myself even as a social smoker." (Hoek et al., 2013b; p.263)	Identification with future smoker or non-smoker identities (#11, 12, 15, 33, 93, 114)	13. Future smoker identities exist	
"A big chunk of my life away and I might not want to go about with the same pals and not being able to do that would be horrible." (Amos et al., p.185)	Concern about loosing the social image and social benefits of being a smoker in case of quitting smoking (#4, 14, 17, 76, 77, 87, 94)	14. Smoker identities influence making a quit attempt	IV. Behaviour in relation to smoking
"Like, I knew consciously that I didn't want to be a smoker." (Johnson et al., 2003; p.391)	Having clear intention to distance oneself from being a smoker can help a person abstain from smoking (#69, 73, 79, 124, 125, 126, 127, 128)	15. Smoker identities influence long-term abstinence	

6.4.3. Framework for the synthesis

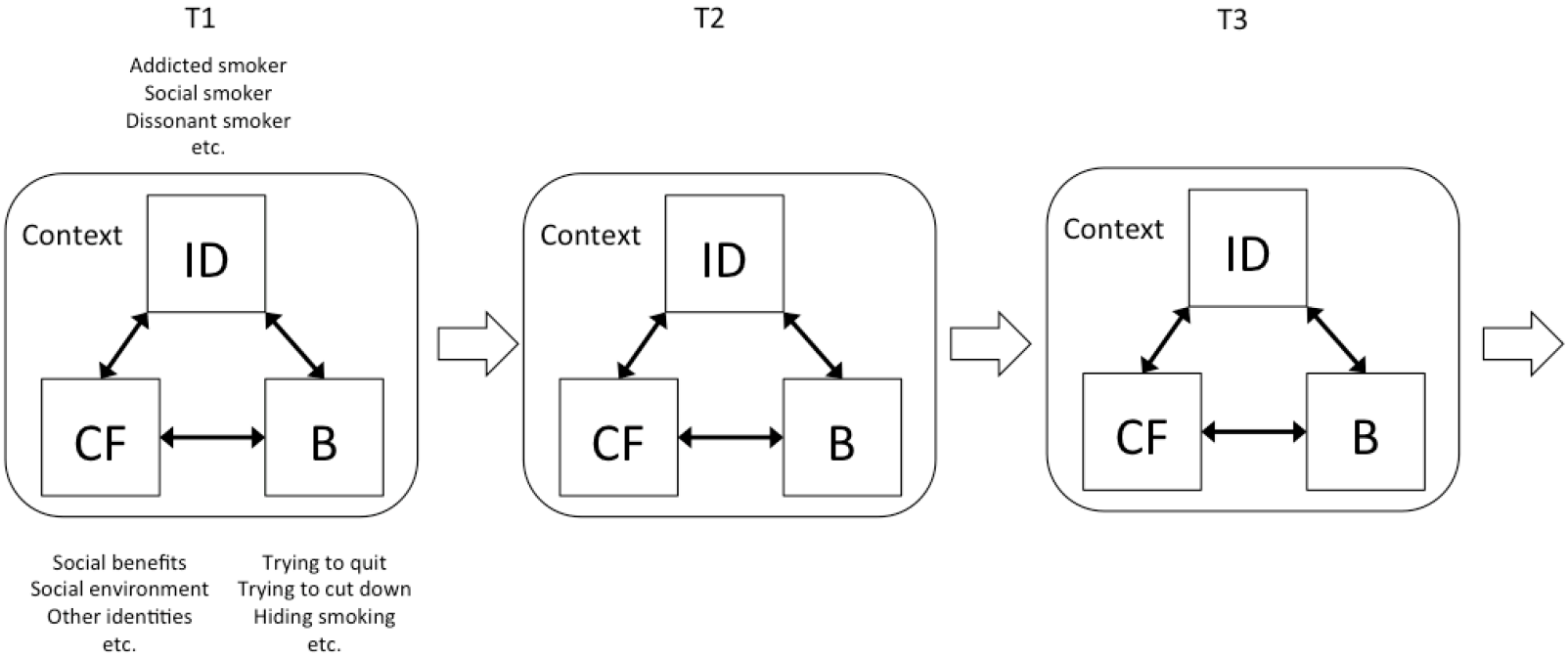
Figure 8 shows the framework for the synthesis. In this framework, context (e.g. being with one's family at home, being with one's friends etc.) conditions the current identity and the factors that contribute to it. Thus, identities may be different and evolve differently in different contexts. In any given context, interrelated individual (e.g. desire to establish aspirational identities through being a smoker), social (e.g. enacting an identity that is appropriate to the relevant social environment) and behavioural factors (e.g. altering personal non-smoking rules if consuming alcohol) contribute to a multifaceted smoker identity that incorporates thoughts (e.g. defensive rationalization), images (e.g. negative self-image as a smoker) and feelings (e.g. identity conflicts due to being a smoker). Therefore, smoker identities are perceived as important in people's self-definition if they satisfy identity motives, including the need to maintain/enhance self-esteem, distinctiveness from others (e.g. non-smokers or daily smokers) and feelings of belonging (Vignoles, 2011). On the other hand, if being a smoker conflicts with motives for self-esteem and/or belonging, young adults hide their smoker identities and use defensive psychological mechanisms to protect their positive self-esteem and social identity. Moreover, salient smoker identities triggered by particular contexts can evoke identity congruent cognitions and influence young adults' self-regulation, such that smoking could be acceptable if consuming alcohol or unacceptable if not deemed the kind of behaviour practised by other in-group members.

A key aspect of the contextual patterning of smoker identity is the possibility for rapid shifts between identities, which provide the basis either for the elimination of internal conflicts or for the behaviour change. Nevertheless, firmly established smoker identities might

increase/decrease the importance of the influence of the contributory factors in a reciprocal association, because if having, for example, a 'confirmed smoker' identity that neither conflicts with the person's identity motives nor causes internal conflicts between other identity aspects, then it will decrease the importance of the social context in terms of inducing change in behaviour or shifts between smoker identities.

The temporal patterning of smoker identity involves long-term evolutionary processes. In line with theories of Social Comparison (Festinger, 1954), Social Identity (Tajfel and Turner, 1986) and Identity-based Motivation (Oyserman, 2009), a strong social embedment is evident not just in terms of establishing smoker identities, but also in the context of managing these identities to maintain a positive social identity. Therefore, once a socially acceptable smoker identity is established (e.g. being a non-daily smoker), people can use it as a means of self-enhancement by comparing themselves to others who are perceived similar to themselves in many aspects (e.g. similar age), but who are also worse off in terms of smoking-related characteristics (e.g. being an addicted daily smoker). Smoker identities can be drivers for health promoting or health destructive behaviours (e.g. identification with a non-smoker identity that is grounded in defensive rationalization could deter smokers from making quit attempts and therefore undermine efforts to achieve long-term abstinence). Finally, smoking and cessation behaviours can also facilitate the establishment of new smoker identities over time (e.g. an unsuccessful quit attempt could induce a 'confirmed smoker' identity).

Figure 8: Framework for the interpretation of smoker identity and identity change in young adults



T1, T2, T3 etc. represent successive episodes of time (an episode can be a bigger or smaller chunk of time when a person is in a particular situation); CF=contributory factors to identity, ID=identity in relation to smoking, B=behaviour in relation to smoking; thin arrows represent causal influence; hollow arrows represent evolution over time. Under this model CF, B and ID interact within a given period of time. They are all influenced by the current context, as are the patterns of influence between them. The system as a whole evolves from episode to episode, and change in any of the components in the system can trigger transitions between episodes.

6.5. Discussion

The 'smoker identity' phenomenon was considerably more complex than a binary construct (i.e. being a 'smoker' vs. 'non-smoker') and many current smoker identities were identified. Moreover, as people proffered mental representations of themselves regarding who they would like to become (e.g. non-smoker identity) and who they are afraid of becoming (e.g. identity as an addicted smoker) in the future, findings from this study suggest that identity aspects related to health behaviours can complement people's possible selves (Markus and Nurius, 1986). Young adults could hold different smoker identities concurrently, and individual, social and behavioural factors could all shape how they perceived their smoker identities and the attitudes they attached to these. Smoker identities might not be established automatically and in tandem with smoking initiation but may be adopted over time and changed intentionally depending on the context. Additionally, different smoker identities could both facilitate and inhibit smoking cessation.

Findings from this meta-ethnography support previous studies that have shown that different smoker identities exist (Farrimond et al., 2010) and that many smokers deny their smoker identities (Choi et al., 2010, Ridner et al., 2010, Levinson et al., 2007, Berg et al., 2009, Leas et al., 2014). The synthesis highlights the potential for long-term changes and short-term fluctuations in young adults' smoker identities that seem to be driven by increasing discrepancies between aspirational and current identities and the desire to maintain a positive social identity in the momentary context (Tajfel and Turner, 1986). This could be particularly relevant during young adulthood when most people begin to establish their professional careers, start a family and have children, because although the sense of belonging to social

groups are still highly valued, discrepancies can occur between these social identities and newly established or aspirational identities related to their professional or personal roles.

Consistent with previous quantitative studies in the literature (Falomir and Invernizzi, 1999, Hoie et al., 2010, Moan and Rise, 2005), findings reported in Studies 1 and 2 in this thesis (reported in Chapters 4.4. and 5.4., respectively), and theories that suggest a dynamic between identity change and behaviour change (Kearney and O'Sullivan, 2003, West, 2006b, West and Brown, 2013) (detailed in Chapter 2.2.2.), this meta-ethnography shows that the extent to which smokers internalize different smoker identities provides a potentially important subjective determinant of motivation to engage in or refrain from smoking. The synthesis highlights that the concept of 'competing identities', that is a conflict between a smoker identity and another personally relevant identity aspect, can be particularly important in energizing behaviour change; thus, it might influence individuals' intentions to make a quit attempt, as reported in Study 1, and the formulation of plans to achieve and maintain that change, as reported in Study 2. Additionally, this meta-ethnography provides further insights into the potential underlying mechanisms that might account for people's identification with a positive smoker identity, as reported in Study 1, including that it can serve personal identity functions or it can be a counter to the social stigma associated with smoking.

In terms of potential practical implications, the synthesis suggests that identity processes, including the internalization/revision of different identities with underlying identity motives and contextual influences, matter in smoking cessation. Therefore, interventions should take account of young adults' different smoker identities, including those who might have a non-smoker identity despite smoking. Moreover, in order to better personalize behavioural

support for cessation, smoker identities should be considered together with other identity aspects. Smokers should be encouraged to articulate what their smoker identities mean to them in order to explore underlying identity motives (Vignoles, 2011). Building on the identity motives identified, interventions should help smokers work out how their identity could be complete without smoking. In particular, interventions should facilitate the establishment of an identity that would satisfy the need to increase self-esteem, distinctiveness from others and maintain feelings of belongings without smoking. Further potentially important targets for interventions to promote identity change and behaviour change could be tackled by established BCTs (Michie et al., 2013a). These include the monitoring of people's commitment to a non-smoker identity throughout the smoking cessation process, and strengthening it if needed; drawing smokers' attention to the discrepancies between their smoker identities and other aspirational identities; and identifying positive role model(s) together with smokers to strengthen their desire to change their smoker identity. Finally, interventions should emphasize that despite being addicted to cigarettes or finding it difficult to quit, it is always possible to change one's identity and become a non-smoker, which could eventually reinforce sustained behaviour change.

Future studies should explore different smoker identities and how these influence behaviour in special populations, different age groups and cultural contexts. We need to advance our knowledge of the ways in which identity motives underlying a smoker identity can be explored and techniques to help people establish an identity that fulfils these needs without smoking. A better understanding of situations with a potential to trigger long-term changes in smoker identities and the ways in which smoker identities might interact with other health-related identity aspects (e.g. physical activity, alcohol consumption) would also be needed.

6.5.1. Limitations

One limitation of this meta-ethnography was that only journal articles published in English were included, and all reported studies were conducted in Western industrialised countries. Moreover, even though the search strategy led to a broad range of studies covering a variety of topics in electronic databases and authors of included papers were contacted to identify further journal articles, grey literature searching was not carried out. Relevant findings might therefore have been omitted.

CHAPTER 7 – PREGNANT SMOKERS' VIEWS ON THEIR CAPABILITY, OPPORTUNITY AND MOTIVATION TO STOP SMOKING (STUDY 4)

7.1. Abstract

Identifying aspects of pregnant smokers' capability, opportunity and motivation that would need to change in order for them to stop smoking is an important initial step in developing new interventions. The COM-B model can be applied as a comprehensive framework for understanding pregnant women's smoking behaviour in context and specifying potential intervention targets. This study obtained in-depth understanding of pregnant smokers' views on the intrapersonal and extrapersonal factors that would need to change in order to achieve smoking abstinence. Structured telephone interviews were conducted with eight pregnant smokers in England. Interviews were coded thematically using the COM-B model as a coding framework. It was identified that pregnant smokers may lack adequate knowledge of available sources of support, and may not have sufficient self-regulatory capacity and effective skills to cope with stress and urges to smoke (psychological capability). Women needed more encouragement and positive role models for cessation (social opportunity), and easily accessible cessation support (physical opportunity). Change would be needed for individuals' habits around smoking (automatic motivation), beliefs about the role of smoking in their life, self-images, self-feelings and self-thoughts (reflective motivation). This study concludes that from the perspective of pregnant smokers, stopping smoking would require greater psychological capability, a more supportive social and physical environment, and change in their beliefs and identity, which might be targeted in interventions to aid cessation.

7.2. Introduction

Although smoking prevalence during pregnancy may be declining in England (McAndrew et al., 2012, HSCIC, 2014, Bolling et al., 2007), the proportion of pregnant women who smoke throughout pregnancy is still approximately 12%, and the prevalence is disproportionately high in young women and in low socioeconomic groups, as discussed in Chapter 1.5.1. (McAndrew et al., 2012, HSCIC, 2014). In order to reduce smoking rates among pregnant women, we need to improve smoking cessation treatment approaches. Developing new cessation aids for pregnant smokers will require a comprehensive understanding of intrapersonal and extrapersonal factors that might have an impact on their behaviour and identifying what needs to be targeted in order to achieve behaviour change. The COM-B framework (Michie et al., 2011d, Michie et al., 2014b) has been widely applied to inform the development of various behaviour change interventions (Robinson et al., 2013, Jackson et al., 2014, Murphy et al., 2014), but little research has been published on its use for a systematic analysis of pregnant women's smoking behaviour during pregnancy to identify intervention targets.

The COM-B model provides a comprehensive framework for identifying sources of a behaviour or behavioural pattern. As detailed in Chapters 2.1.3. and 2.2.1., this model suggests that behaviour arises as a result of interacting intrapersonal factors (aspects of people's capability and motivation) and extrapersonal conditions (aspects of people's environmental opportunity). 'Capability' refers to individuals' physical and psychological capability to perform the behaviour, including knowledge, and both mental and physical skills, strength and stamina. 'Motivation' involves wants and needs to engage in the

behaviour, including automatic motivation, such as drives, emotional states and habits, and reflective motivation, such as beliefs, evaluations and identity. 'Opportunity' encompasses people's social and physical environment, including cues prompting the behaviour, the physical accessibility and affordability of performing the behaviour, and social norms and acceptability of a particular behaviour.

The COM-B model fits within the BCW, as discussed in Chapter 2.1.3., which provides a comprehensive guide for designing and evaluating complex interventions based on the synthesis of 19 previously published frameworks of behaviour change (Michie et al., 2014a, Michie et al., 2011d). The BCW recommends analysing one or more target behaviours, on which the intervention is intended to have an impact, to inform the specification of intervention functions, the BCTs delivering the selected intervention content and the suitable policy categories by which the implementation of the intervention can be supported (Michie et al., 2011d). In line with this principle, identifying what would need to change in pregnant smokers' capability, opportunity and motivation in order for them to achieve smoking abstinence is one of the important initial steps in developing new interventions to aid cessation among pregnant women.

In terms of intrapersonal sources of smoking during pregnancy, previous studies have reported that pregnant smokers are motivated to quit primarily to avoid the adverse consequences of smoking on the baby's health (reflective motivation) (Ussher et al., 2004, Bull et al., 2007, Hoek et al., 2014, Krstev et al., 2012); however, lack of detailed knowledge of the specific consequences of smoking in relation to their pregnancy and children's health (psychological capability) can be a barrier to committing themselves to the behaviour change

(Bull et al., 2007, Gould et al., 2013, Polen et al., 2015). Important aspects of reflective motivation, such as having low self-confidence in ability to stop smoking (Maxson et al., 2012, Woodby et al., 1999, Ingall and Cropley, 2010) and holding beliefs that smoking has a firmly entrenched role in their life and identity (Gould et al., 2013, Bull et al., 2007, Flemming et al., 2013) might contribute to smoking during pregnancy. Similarly, aspects of automatic motivation, such as having strong nicotine dependence, difficulty in breaking the smoking habit (Alves et al., 2013, Schneider et al., 2010, Gould et al., 2013), and difficulty in coping with negative emotional states (psychological capability), such as stress, anxiety and depressed mood (Al-Sahab et al., 2010, Hauge et al., 2012, Baron et al., 2013, Scott et al., 2009), could also undermine pregnant smokers' efforts to cessation.

Environmental factors represent important influences on smoking behaviour. It has been consistently found that having a smoker partner, being part of social groups in which smoking is accepted (social opportunity), or living in a household where smoking is permitted (physical opportunity) could facilitate smoking during pregnancy (Hoekzema et al., 2014, Schneider et al., 2010, DiClemente et al., 2000, Ingall and Cropley, 2010). On the other hand, both social influences, such as perceived negative attitude towards pregnant smokers (Bull et al., 2007), and physical environmental factors, such as financial incentives for smoking abstinence (Tappin et al., 2015, Higgins et al., 2012, Bauld and Coleman, 2009, Chamberlain et al., 2013, Mantzari et al., 2012), can prompt cessation.

7.2.1. Aims and research questions

Overall, a number of potentially useful targets have been identified in the literature for

interventions to aid cessation during pregnancy, but it is important to systematically explore pregnant smokers' perspective on what contributes to their smoking behaviour and how their circumstances would need to change in order to achieve smoking abstinence. Therefore, this study aimed to obtain in-depth understanding of pregnant smokers' views on their intrapersonal characteristics and environmental factors in relation to smoking and cessation in order to inform the content specification of a new smartphone app for pregnant smokers. The following research questions were addressed:

1. How do pregnant smokers perceive their capability to stop smoking?
2. How do pregnant smokers perceive their opportunity to stop smoking?
3. How do pregnant smokers perceive their motivation to stop smoking?

7.3. Methods

7.3.1. Study design

Structured qualitative interviews were conducted over the phone at pre-arranged dates and times between April and October in 2013. This interview design was chosen because the structured interview guide allowed the collection of in-depth information on specific topic areas in line with the COM-B framework, whilst the open-ended questions permitted participants to elaborate their thoughts and feelings in relation to the different topics mentioned. Informed consent was sought from everyone prior to the interview, and confidentiality and anonymity were assured. Participants received high-street vouchers worth £30 to compensate them for their time and effort. Ethical approval for this study was obtained

from the UCL Research Ethics Committee (Project IDs: 3556/002 and 3556/004).

7.3.2. Participants

Participants were recruited from various settings as follows. Online advertisements of the study were placed on the Tommy's website (www.tommys.org), which is a nationwide charity for pregnant women and babies, and information leaflets with consent forms and pre-paid envelops were distributed in the premises of eight community children centres across London, the Midlands and North West England. In addition, 67 women who participated in a pilot RCT of a smoking cessation website for pregnant women (MumsQuit) (Herbec et al., 2014b) and provided consent to be contacted for a telephone interview were invited to participate in this study. Participation was voluntary.

Pregnant women (age 16 and over) who smoked cigarettes daily or occasionally and were interested in stopping smoking were included in the study. A total of 16 participants expressed interest in participating in the telephone interviews. Of these, one participant withdrew before the interview, six participants were excluded because they did not meet the inclusion criteria of this study (four participants quit smoking, and two were no longer pregnant at the time of contact) and one participant was not available after five attempts of contacting her. Table 16 shows the characteristics of pregnant smokers (n=8) who participated in the interviews.

Table 16: Background characteristics of pregnant smokers participating in the telephone interviews in Study 4

	Total sample (n=8)
Demographic and pregnancy characteristics	
Age, Mean (SD); range	23.4 (5.5); 17-30
C2DE social grade, % (n)	87.5 (7)
Weeks of pregnancy, Mean (SD); range	21.0 (9.3); 11-36
Smoking-related characteristics	
Heaviness of Smoking Index, Mean (SD)	2.8 (1.0)
Motivation To Stop Scale (range: 0-7), Mean (SD)	5.2 (2.1)
Quit attempt in the past year, % (n)	75.0 (6)

7.3.3. Measures

Prior to the main interview, data on participants' background characteristics were collected. Participants were asked about their demographic and pregnancy characteristics (age, social grade and weeks of pregnancy). In line with Study 1 and Study 2 in this thesis (Chapters 4.3.3. and 5.3.3., respectively), social grade was measured according to the British National Readership classification system, and dichotomised into ABC1 (those with higher and intermediate professional/managerial, supervisory, clerical, junior managerial/administrative/professional occupations) and C2DE (those with skilled, semi-skilled and unskilled manual, and lowest grade occupations, or unemployed). In addition, participants' nicotine dependence was measured with the established HSI (Heatherton et al., 1989) and their motivation to stop was measured with the MTSS (Kotz et al., 2013a) (details of each measure are discussed in Chapter 4.3.3.). Data on serious quit attempts in the past year were collected ('How many serious quit attempts to stop smoking have you made in the

last 12 months? By serious attempt I mean you decided that you would try to make sure you never smoked again. Include any attempt that you are currently making'). Data obtained from the pre-interview questions were used only for contextual understanding of the interviews.

7.3.4. Procedure

The main telephone interviews lasted approximately 30-45 minutes, during which a structured interview schedule was followed (reported in Appendix D-6) to ensure that the same topics were covered in each interview. At the beginning of the interviews, participants were reminded that the aim was to explore pregnant smokers' experiences with smoking and smoking cessation to find better ways to help them quit smoking, and that the interviews were audio-recorded and they had the right not to answer any questions and to withdraw at any time without giving a reason.

Development of the interview schedule involved discussion between Robert West, Lion Shahab, Susan Michie and myself, and several iterations of the schedule were produced until agreement was reached that each component of the COM-B framework (capability, opportunity and motivation) was adequately addressed. Therefore, to ensure that the full range of potential sources of behaviour was represented in the interview schedule, questions covered pregnant smokers' physical and psychological capability, environmental and social opportunity and automatic and reflective motivation to stop smoking, and to elicit comprehensive accounts from participants, open-ended questions were used.

7.3.5. Analysis

All interviews were transcribed *verbatim* and the data were analysed thematically (Braun and Clarke, 2006) from a naïve realist epistemological position that is based on the assumption that the world is knowable, and perceived directly as it is (Madill et al., 2000). Transcripts were coded manually around *a priori* themes referring to the main components of the COM-B framework: capability, opportunity and motivation. Data were assigned multiple codes, where appropriate. Then the coded data were reviewed to identify specific sub-themes as follows. Pregnant smokers': 1) physical and psychological capability; 2) environmental and social opportunity and 3) automatic and reflective motivation to achieve smoking cessation. Quotations were selected to illustrate key issues in relation to each identified aspect of the COM-B model, and anonymised codes (comprising each individual's study identification number and age) were applied to identify participants. Data analysis was conducted manually and no qualitative software was used.

7.3.6. Contributions

I conceived and designed this study, reviewed the literature and wrote up the interview schedule. I also contacted participants, conducted and transcribed the interviews, analysed the data and wrote up the final study. Robert West and Lion Shahab contributed to the interview schedule and to the write up of the study. Jamie Brown and Aleksandra Herbec assisted in the recruitment and contributed to the write up of the study. Susan Michie contributed to the interview schedule. Beckie Lang, on behalf of the Tommy's charity, assisted in the recruitment.

7.4. Results

7.4.1. COM-B analysis of smoking cessation during pregnancy

Table 17 reports the results of the behavioural analysis. Apart from physical capability, all COM-B components were identified in pregnant smokers' accounts as potentially important to smoking cessation during pregnancy. Specifically, aspects of pregnant smokers' psychological capability, including knowledge, self-regulation and skills, their automatic and reflective motivation and particular characteristics of their social and physical environment were identified. Details of each identified aspect are discussed as follows.

I. Pregnant smokers' views of their psychological capability to stop smoking

1. Knowledge of the health consequences of smoking during pregnancy

Pregnant smokers expressed that they had a general understanding of the ways in which smoking damages their health, partly because they had already begun to experience some of the negative health effects attributed to smoking, such as they had respiratory symptoms frequently. Although women reported that they were also aware of the risks of smoking for the pregnancy, the extent to which the potential incidence of these health effects would need to be taken seriously was sometimes questioned.

"I don't want to harm my baby. I don't want to have a stillborn, or miscarriage or anything like that. So everything that midwives tell you, but I don't know if they say it to

scare you or it's actually true." (P2 Age 17, 36 weeks pregnant)

Nevertheless, participants argued that if they had a better understanding of the health consequences of smoking for their baby, it would help them maintain engagement with smoking cessation throughout their pregnancy.

"Also, to give facts about how well you're doing and reasons why not to have the next cigarette, and explain what's happening in your body, so to say that when you're smoking, this and this and this is happening. So information on all these would be quite helpful. Especially having this during the first two weeks on a daily basis, because you need constant reminders every day." (P5 Age 30, 36 weeks pregnant)

2. Knowledge of available sources of support and effective methods of cessation

Interviewees commented that they had tried a range of methods to support their current or previous quit attempts, including one-to-one and group behavioural support delivered by stop smoking advisers, smoking in pregnancy specialist midwives or pharmacists, pharmacotherapy (such as nicotine gum, nicotine patch and nicotine inhalator), self-help materials (such as books, leaflets and websites), acupuncture and electronic cigarettes. On the other hand, women who had not yet attempted to quit or who had tried to quit unaided in previous attempts were unsure about the types of support that would be available and recommended in pregnancy. Thus, they emphasized that they would need more information about the ways in which they could access to specialist support.

"I don't know who to ask, which is quite sad really because there are pregnant smokers out there who want to quit but don't know who to get support from." (P2 Age 17, 36 weeks pregnant)

Even those who were aware of potential sources of support felt that they lack knowledge of effective methods of stopping smoking in pregnancy. For example, although some women were advised to use different forms of NRT, others were unsure whether they could use pharmacotherapy at all; therefore, participants highlighted the importance of learning more about what they could use to improve their chances of quitting.

"I think there're lot of different types of support available and I contacted a stop smoking midwife to give me some advice, but she still hasn't got in touch with me. So all I would need is just a bit of advice, and for example if nicotine replacement causes harm, so advice on that really." (P1 Age 21, 16 weeks pregnant)

3. Self-regulation to achieve smoking abstinence

Pregnant smokers in this study highlighted that they were able to reduce the number of cigarettes they smoked, but they found it particularly difficult to stop smoking completely. Compared with their previous attempts to quit, participants felt that it would require them to make more efforts and have more mental energy to achieve abstinence during pregnancy.

"It's so much more difficult now [during pregnancy]. I thought it's gonna be easier, but it's so not. For me, I was planning to stop before I got pregnant, but then I got pregnant

and then I thought than I'm gonna stop now, but I can't give up." (P6 Age 27, 11 weeks pregnant)

Specifically, participants reported that they did not have strong enough self-regulatory capacity, referred to as *"willpower"*, to make a quit attempt and to maintain abstinence in situations, in which they would need to overcome desires and impulses to smoke, such as when they were around other smokers or experienced stress.

"Obviously, being pregnant I really think I should stop now, but I'm just not as strong enough to do it. Mentally, I would have to stop and not smoke again, because I did stop for two days, but then I just really really wanted to have another fag." (P7 Age 31, 20 weeks pregnant)

4. Skills to cope with stress and urges to smoke

It was consistently raised that the lack of effective skills to cope with excessive levels of daily stress and anxiety, which were perceived as a result of not being able to quit smoking, having general health concerns about the pregnancy and going through major lifestyle changes, was one of the mayor obstacles to successful cessation during pregnancy.

"Being pregnant I'm thinking about many different things, like if everything is ok with the baby, moving house and loads of different things are just stressing me out, and like before it was 'Oh, I'm stressed, so I'm just gonna have a fag', but now it's like 'Oh, I'm stressed, what I'm gonna do?'." (P8 Age 18, 16 weeks pregnant)

Additionally, pregnant smokers identified that they did not have appropriate mental strategies to cope with urges to smoke and withdrawal symptoms. Therefore, improving their skills to cope with momentary desires to smoke, such as by learning how to substitute smoking with alternative activities in order to distract themselves from immediate urges to smoke, deemed potentially useful.

> *"I would think about having cigarettes, even though I would have the patches. So even though I don't need a cigarette, because I have the nicotine from the patches, I'd still keep thinking about having a cigarette. I just mentally think about it all the time. It doesn't need to be in any particular situation; it's just something I've been doing for such a long time, so it became part of my life. […] I should probably think about the things that I can do, for example to take my daughter to the park, because when I'm out with her in the park, I obviously don't smoke. And there's more distraction anyway so I don't smoke." (P7 Age 31, 20 weeks pregnant)*

II. Pregnant smokers' views of their social and physical opportunity to stop smoking

5. Social acceptability of smoking during pregnancy

Participants stated that the social pressure to quit smoking made it more difficult to achieve abstinence, because it generated additional stress and negative feelings to cope with that undermined their efforts to cessation. Although pregnant smokers generally felt to be judged by members of the society and that of their immediate social groups, being excused for

smoking during pregnancy and normalizing their behaviour were perceived as equally unhelpful.

> *"There is a lot of pressure on pregnant women from people who you work with, from family, friends that you should stop. But then you'll also have some people who would say that 'My mum used to smoke and she was pregnant with me and I turned out perfectly fine' and you don't need to hear these either, because it doesn't help." (P5 Age 30, 36 weeks pregnant)*

6. Social support to quit smoking during pregnancy

Pregnant smokers stressed that a supportive social environment could serve as a much-needed source of encouragement in order to help them overcome barriers to quitting and maintaining abstinence. There were women who expressed that they were satisfied with the support provided by their loved ones and health care providers (e.g. clinicians, stop smoking advisers and midwives); however, it was repeatedly argued that receiving more social support would be a critically important factor that could contribute to smoking cessation during pregnancy.

> *"I've tried the NHS services a couple of times, they were ok, but they didn't really give me any support or information or anything, they just gave me the prescription for NRT and that's it." (P3 Age 24, 21 weeks of pregnancy)*

In terms of expert support, women noted that they would prefer having regular face-to-face interactions with a stop smoking adviser or a midwife throughout pregnancy and also in postpartum. Participants believed that intensive motivational support could increase their confidence in their ability to stop smoking; nevertheless, automated forms of support, such as motivational messages sent via internet or text-messages, were also viewed as potentially helpful.

> *"Maybe one-to-one support, and encouragement probably once a week and then text messages to check how you are getting on. I know what smoking does, how bad it is, I don't need more information on this, but what I need is more encouragement." (P3 Age 24, 21 weeks pregnant)*

7. Social cues for smoking and triggers to prompt cessation

Pregnant smokers reported that they frequently interacted with other smokers, given that either they lived with a smoker partner, had smoker friends or shared the same household with parents who were also smokers. It was generally expressed that being exposed to other people's smoking behaviour at home or in any social situations provoked strong desires to smoke and undermined efforts to cessation. Women reported that although their partners tried to be considerate and not to smoke when they were around, only the complete avoidance of these situations could help them stop smoking.

> "*What doesn't help is that my husband smokes as well. He smokes rolling tobacco, and when he rolls it and sits there and he's just looking at me and I feel that I'd just pick one*

up and smoke it. But then I feel terribly guilty. He started giving up on Monday, so hopefully it'll help me too." (P5 Age 30, 36 weeks pregnant)

On the other hand, positive role models in pregnant women's social environment, such as their partner, mother or a friend who quit smoking, might prompt behaviour change and enhance motivation to stop smoking during pregnancy.

"If you'd see someone else who is doing it [stopping smoking] that would make you think that I can do it." (P1 Age 21, 16 weeks pregnant)

8. Physical environmental cues for smoking and triggers to prompt cessation

In addition to the social cues for smoking, pregnant women identified that various characteristics of their physical environment prompted smoking; thus, they agreed that keeping indoor spaces completely smokefree and putting all cigarettes out of sight would be needed in order to help them make a quit attempt and remain abstinent. Beyond this, participants highlighted the importance of identifying potential sources of distraction in their environment (e.g. going out to the park) and receiving feedback on their progress, such as having their expired air CO level monitored regularly, which would help them maintain their engagement with the behaviour change.

"*I think something that would help, because I see these things on the programmes I watch, is that people need to blow into a machine and that would tell them how much carbon monoxide is there in their body. So something like that would definitely help.*

Because I would have a real idea about what is going on." (P7 Age 31, 20 weeks pregnant)

9. Accessibility of cessation support and resources

Accessing different types of smoking cessation support, such as face-to-face support or various digital aids, was relatively easy for some women in this study, but others had difficulty in travelling to local smoking cessation clinics and getting an appointment with a specialist stop smoking adviser within a few weeks.

"As I work during the day, and that's usually the surgery time as well, so obviously when I don't work, I look after my other daughter, so it's not overly easy to go to somewhere. I just need to find a way to do it [stop smoking] by myself. That's why I looked at the internet, so to get some support from there." (P7 Age 31, 20 weeks pregnant)

In terms of resources, interviewees expressed their positive and negative experiences with different types of smoking cessation support, such as finding useful information on a smoking cessation website or experiencing negative side effects when using NRT. However, regardless of the nature of their experiences with using NRT, pregnant smokers consistently emphasized that they would need these products to support their quit attempts.

"Chewing gum and patches. That'd be it really. But obviously, I can't have patches or anything because I'm pregnant, so it's really difficult. I've tried to quit, but it was quite hard." (P2 Age 17, 36 weeks pregnant)

III. Pregnant smokers' views of their automatic and reflective motivation to stop smoking

10. Habitual aspects of smoking and negative emotional states

Smoking was reported to be a long-standing habit for participants. Despite their relatively young age, they have been smoking for many years; therefore, the habitual aspects of smoking, such as its firm embeddedness in pregnant smokers' daily routine, the hand movement involved and the withdrawal symptoms, were identified as important barriers to cessation.

"*I think it's [quitting] not that difficult if I think about it sensibly, but the actual physical habits of it is the difficult bit. It's more a habit than an addiction, so you'd need to break that habit." (P7 Age 31, 20 weeks pregnant)*

In addition, participants recognized that they became more emotionally sensitive during pregnancy than they had been before, and that negative emotional states, particularly when they were feeling stressed or irritated, were important drives for smoking that undermined their efforts to remain abstinent.

"I tried to quit twice, but it seems to be harder now when I'm pregnant, I don't know, maybe it's about stress, worrying about things, so I wanna smoke more than I usually would. […] Not being pregnant would obviously help me in terms of stopping smoking,

because now I feel that I'm not able to do it, because I'm under a lot of stress." (P3 Age 24, 21 weeks pregnant)

11. Beliefs about the role of smoking and reasons to quit

Smoking was primarily viewed as a useful strategy to cope with stress, and it was argued that it helped pregnant smokers manage their anxiety, irritability and boredom. Equally importantly, women expressed that smoking represented a source of enjoyment and provided a much-needed break to have their own time during the day.

"*When you know something stressful is gonna happen, you know that a fag will calm you down, so you just have one. I enjoy the smoking. It really does sound silly, but it calms you down. It makes you feel good. I really want to stop, but I do enjoy it a lot. It's about the feeling. The feeling of calmness when you smoke." (P6 Age 27, 11 weeks pregnant)*

Despite the aforementioned positive aspects of smoking, pregnant women in this study thought that smoking during pregnancy was a bad thing to do and they were motivated to quit for a number of reasons, as follows. Women stressed that they wanted to protect their baby from the health consequences of smoking during pregnancy and that of passive smoking after birth. Concerns about the short-term and long-term effects of smoking on their own health also became more significant as a result of expecting a baby. Generally, women believed that increased life expectancy and better mental and physical health, both for themselves and their children, would be associated with quitting.

"This time it's the baby [what motives me to quit]. I really don't want to smoke around him. Also, I don't want to smell bad. So I don't want to stop because of the health stuff, because I've never really thought about this, but now that I'm pregnant I got to be healthy." (P6 Age 27, 11 weeks pregnant)

Furthermore, women wanted to avoid the unattractive characteristics of smoking, such as the extensive costs, and an important motivational force was that their friends and family also persuaded them to stop smoking. Participants recognized the positive social consequences that would follow their successful quit attempt, such as that their loved ones would be proud of them and they would receive more support in the long-term, all of which would help them maintain abstinence.

"I think they [my family] would be really pleased with that [if I quit smoking]. I think most of them would be supportive, but also some would have some doubts in me that I can quit. I think if I managed to quit for a number of days, they gradually become more supportive, because they'd see that I really mean to do it, because now they'd just say 'well, you can't do it'." (P1 Age 21, 16 weeks pregnant)

12. Identity in relation to smoking and cessation

Pregnant smokers felt bad about themselves because of smoking. They had negative self-images, felt guilty about being a mum who smokes and who needs to hide it from her loved ones, and they had very low confidence in their ability to change their smoking behaviour.

"I'm not very proud of myself. It makes me feel really sad. It's quite obvious now that I have to stop, but I still can't do it. I'd like to think I do everything I can [for the baby], I mean I don't drink, but it's just the smoking." (P7 Age 31, 20 weeks pregnant)

On the other hand, becoming a non-smoker was viewed to be associated with increased self-efficacy (e.g. accomplishing the behaviour change goal) and better self-esteem, as this aspirational identity comprised positive self-images (e.g. being someone who smells good), self-feelings (e.g. being proud of oneself) and self-thoughts (e.g. considering oneself as a good role model for one's child).

"I'd feel good about myself that I'm not wasting my life any more, you know, on a silly thing [smoking]. They [cigarettes] don't do anything for me, they don't bring anything good into my life, and now that I've got a child I just want to be around my child, play with my child and I want my child to grow up with the same mind-set that smoking is not good, so they could live a happier life as well. That's how I see my future as a non-smoker." (P8 Age 18, 16 weeks pregnant)

Moreover, it was raised that stopping smoking could improve other conjunctive health behaviours, such as physical activity, whereby it might foster the establishment of an identity as a 'health-conscious person'.

"I don't exercise at the moment, but I do feel if I quit I'd exercise a bit more, so it [stopping smoking] would make me a healthier person overall." (P1 Age 21, 16 weeks pregnant)

Table 17: COM-B behavioural analysis of smoking cessation in pregnancy in Study 4

COM-B components	Sub-domains	Specific aspects of sub-domains	Change needed in order to alter smoking behaviour during pregnancy
Capability	Psychological capability	Knowledge	Improve knowledge of the health consequences of smoking for the pregnancy and the baby. Improve knowledge of available sources of support and how to access it. Improve knowledge of available methods of smoking cessation, such as nicotine replacement therapy, and how to use them during pregnancy.
		Self-regulation	Strengthen self-regulation against intrapersonal and extrapersonal smoking cues.
		Skills	Improve skills to cope with stress and anxiety. Improve skills to cope with urges to smoke.
Opportunity	Social environment	Acceptability	Shift social norms to a non-judgemental supportive denormalization of smoking during pregnancy.
		Social support	Provide more social support and encouragement.
		Social cues and triggers	Restructure social environment to avoid exposure to other people's smoking behaviour. Provide positive role models for smoking cessation.
	Physical environment	Environmental cues and triggers	Remove cues for smoking from the environment and keep indoor spaces smokefree. Provide feedback on progress, preferably by measuring expired-air carbon monoxide. Identify potential sources of distraction to overcome urges to smoke.
		Accessibility of support and resources	Provide readily available and easily accessible support for cessation. Provide nicotine replacement therapy to support quit attempts.

COM-B components *(continued)*	**Sub-domains**	**Specific aspects of sub-domains**	**Change needed in order to alter smoking behaviour during pregnancy**
Motivation	Automatic motivation	Habit and emotional states	Change daily routine to break smoking habit. Have established strategies to cope with negative emotional states without smoking.
	Reflective motivation	Beliefs	Challenge beliefs that smoking reduces stress and anxiety. Hold beliefs that smoking can be substituted with alternative activities to relax. Hold beliefs that stopping smoking would be a good thing to do and it would have positive health, financial and social consequences.
		Identity	Foster a positive non-smoker identity with positive self-images, self-feelings and self-thoughts attached to it.

7.5. Discussion

Young pregnant smokers in England identified a range of potentially useful targets for behaviour change interventions to aid smoking cessation during pregnancy. From their perspective, stopping smoking would require greater psychological capability, such as having better skills to cope with stress and urges to smoke, and learning more about effective methods of cessation. Pregnant smokers indicated that a more supportive social environment, by means of a non-judgemental social attitude towards pregnant smokers and positive role models for quitting, could help them with their quit attempts. In terms of physical environment, a need for easier access to cessation aids and feedback on their progress with quitting need to be addressed. Pregnant smokers identified that holding the belief that smoking helps with reducing stress can be an important barrier to quitting and this need to be targeted in interventions to promote cessation.

Findings from this behavioural analysis showed that apart from physical capability, all sub-domains of the COM-B model were identified as relevant in relation to smoking cessation during pregnancy. Consistent with previous studies in the literature, this study showed that young smokers in England may lack sufficient knowledge of the harmful health effects of smoking (Bull et al., 2007, Gould et al., 2013, Polen et al., 2015), and they may underestimate the potential risks (Tombor et al., 2010, Naughton et al., 2013a). The behavioural analysis supports previous findings, in that pregnant women in this study reported not having strong enough self-regulatory capacity to maintain complete smoking abstinence throughout pregnancy (Gould et al., 2013, Herbec et al., 2014a), but they felt that they could cut down the number of cigarettes to reduce the harm of smoking for their baby

(Graham et al., 2013, DiClemente et al., 2000, Gould et al., 2013).

In terms of environmental factors, there has been a long debate on the use of smoking denormalization strategies to promote behaviour change in the general population (Bayer, 2008, Burris, 2008), and previous studies have found that the perceived negative social discourse could increase motivation to quit smoking during pregnancy (Bull et al., 2007). However, this study suggests that a supportive non-judgemental denormalization social approach might be more useful for enhancing pregnant smokers' motivation to achieve smoking abstinence during pregnancy. Consistent with previous research, this study indicates that pregnant smokers would need positive role models in their social environment (Herbec et al., 2014a) to counteract the barriers posed by being surrounded with smokers in their immediate social groups (Hoekzema et al., 2014, Schneider et al., 2010, DiClemente et al., 2000, Ingall and Cropley, 2010). In addition, the importance of having readily available cessation support was identified (Butterworth et al., 2014, Herbec et al., 2014a).

This behavioural analysis suggests that change might be needed in pregnant smoker's beliefs regarding smoking, so that they would not hold a common belief that smoking helps with reducing stress and anxiety (Mantzari et al., 2012). Additionally, it was proposed in Study 3 in this thesis (Chapter 6.4.3.) that there might be a reciprocal association between people's identities in relation to smoking and health promoting or health destructive behaviours, and the COM-B analysis appears to support this claim by indicating that a non-smoker identity among pregnant smokers might influence their engagement with health promoting behaviours beyond smoking cessation, and this merits further research.

To inform intervention development, this study suggests that a combination of pregnant smokers' capability, opportunity and motivation would require change in order to alter smoking behaviour during pregnancy. Some of the specific aspects that were identified by participants as potentially useful targets for interventions, including increasing awareness of the risks of smoking during pregnancy, strengthening self-regulation, improving coping skills, providing feedback on progress and facilitating problem solving, refer directly to BCTs that are evidence-based for smoking cessation behavioural support in pregnancy (Lorencatto et al., 2012). Moreover, providing information about different forms of cessation aids, providing social support and boosting self-efficacy are effective BCTs in the general population (Michie et al., 2011c, West et al., 2010). Beyond these, providing positive role models for quitting, and harnessing a non-smoker identity may also be important.

Digital interventions can be suitable for targeting most of the factors identified in this study. In particular, digital aids can serve as a readily available and easily accessible source of support, and they can be used to provide evidence-based information on a broad range of topics in relation to smoking and cessation in order to improve pregnant smokers' knowledge and coping skills. To encourage pregnant women to maintain their engagement with the behaviour change, motivational messages can also be easily delivered throughout pregnancy. On the contrary, digital interventions might be less suitable for prompting change in pregnant women's social environment in terms of the norms and attitudes towards pregnant smokers, for which mass media campaigns may be more appropriate. Similarly, in order for pregnant smokers to benefit from more intensive behavioural support, CO monitoring and NRT, digital interventions should be accompanied by face-to-face support.

Findings from this study show good correspondence with previous studies from Western industrialised countries that examined the potential sources of smoking behaviour during pregnancy. Given that digital behaviour change interventions, particularly online interventions and smartphone apps, have the potential to be available anywhere, they can provide a unique opportunity to deliver evidence-based smoking cessation support with no extra costs for pregnant women from geographic areas with limited or no access to face-to-face support. Therefore, it would be important to explore the intrapersonal and extrapersonal contributing factors to pregnant women's smoking and cessation behaviour outside Western societies to establish the extent to which the identified intervention targets are transferable to different cultures and populations.

7.5.1. Limitations

The main limitation of this study is its small sample size, as despite the various recruitment strategies employed and the high number of potential participants approached, only eight pregnant smokers participated in the telephone interviews; therefore, those who agreed to participate might have been more motivated to quit smoking. Nevertheless, participants were young pregnant smokers at different stages of pregnancy and from low socioeconomic groups, who are typically hard to reach and engage with, and they were recruited from a large geographic region in England. Additionally, there was a good correspondence between the interviews, as participants identified similar issues in relation to the different topics in question in this study, which might indicate that saturation was reached.

CHAPTER 8 – HEALTH CARE PROVIDERS' VIEWS ON DIGITAL SMOKING CESSATION INTERVENTIONS FOR PREGNANT SMOKERS (STUDY 5)

8.1. Abstract

Digital interventions may benefit pregnant smokers who do not engage with face-to-face support or who want to supplement that support. Health care providers (HCPs) who interact with pregnant smokers may have valuable insights into their development and use. This study explored HCPs' views of using digital aids with pregnant smokers in order to inform the design and delivery of new interventions. Two structured focus groups were conducted with HCPs (n=16) in England. Discussions covered HCPs' general views about digital aids, the potential of such interventions for cessation support for pregnant smokers, and recommendations for intervention development. Transcripts were analysed thematically. HCPs identified a variety of ways in which digital interventions could benefit pregnant smokers, such as by offering consistent quality of advice and being available on demand. Limitations included lack of access among those most economically disadvantaged, the need for high levels of self-motivation, and lack of human contact. Addressing pregnant smokers' negative perceptions of smoking cessation support, providing rewarding experiences, and tailoring the intervention to smokers' level of confidence were among HCPs' recommendations. This study concludes that from the perspective of HCPs, digital interventions offer a range of potential benefits that could make them useful for pregnant smokers. Nonetheless, important limitations and recommendations regarding their design and delivery were identified and these need to be addressed in intervention development.

8.1.1. Dissemination

A version of this chapter is currently in press in the *Journal of Smoking Cessation* (reported in Appendix E-7). Details of this publication are as follows.

Tombor, I., Neale, J., Shahab, L., Ruiz, M., West, R. (in press). Health care providers' views on digital smoking cessation interventions for pregnant women. *Journal of Smoking Cessation,* Published online: 10 March 2014. Doi: 10.1017/jsc.2014.6

8.2. Introduction

Digital interventions – a rapidly evolving new approach to aid behaviour change – might help smokers to quit (Civljak et al., 2013, Myung et al., 2009, Shahab and McEwen, 2009, Whittaker et al., 2012, Chen et al., 2012), and could benefit particular groups such as pregnant women (Naughton et al., 2012, Pollak et al., 2013, Herbec et al., 2014b). Regular interaction with pregnant smokers could afford HCPs, primarily midwives and stop smoking advisers, valuable insights into effective methods of providing smoking cessation support for this population, which can be used to inform the design and delivery of new interventions. In addition, their frequent contact with pregnant women may enable them to act as portals for accessing any digital aids that might be developed; therefore, it would be useful to learn more about HCPs' views of digital smoking cessation interventions for pregnant smokers, which have yet to be explored in this context.

Frequent appointments during pregnancy represent a valuable opportunity for HCPs to keep health behaviour change in mind, monitor smoking status and provide brief smoking cessation support for women (NICE, 2014). As discussed in Chapter 1.5.4., the general practice in the UK involves that pregnant smokers can benefit from more intensive face-to-face support either by attending a stop smoking service or by requesting home visits (NICE, 2010). However, the uptake of interventions is low (Tappin et al., 2010) and barriers to smoking cessation support have been identified at each of the following steps: identification of pregnant smokers, referral to specialist smoking cessation services, engagement with services, and smoking cessation treatment (Tappin et al., 2010, Beenstock et al., 2012).

From the perspective of pregnant smokers, having negative feelings about smoking cessation services and speaking with a health professional, and having difficulties in accessing the health care facilities are potential reasons for their reluctance to engage with face-to-face support (Ussher et al., 2006, Ingall and Cropley, 2010, Herberts and Sykes, 2012). Additionally, findings from a COM-B analysis in Study 4 (Chapter 7) showed that pregnant women might not have sufficient knowledge of available sources of support and the ways in which they can access to it. Barriers identified by HCPs include lack of time and competing priorities during appointments, fear of causing guilt and shame, and fear of putting extra pressure on pregnant smokers by prompting smoking cessation (Herberts and Sykes, 2012, Abatemarco et al., 2007, Price et al., 2006, Thyrian et al., 2006, Beenstock et al., 2012).

Previous studies have suggested that there might be scope for digital interventions to address some of the barriers to engaging with effective smoking cessation support during pregnancy, since these programmes do not require face-to-face contact, are available any time, and

appear to be acceptable for pregnant smokers (Naughton et al., 2013b, Naughton et al., 2012, Pollak et al., 2013, Herbec et al., 2014a, Herbec et al., 2014b, Soklaridis et al., 2014). However, as detailed in Chapter 1.5.4., only a few digital smoking cessation interventions have been designed specifically for pregnant smokers. Equally, there is little published research on what would constitute an effective digital smoking cessation intervention for this population in terms of content, features and mode of delivery.

8.2.1. Aims and research questions

Overall, studies have suggested that digital interventions might meet the needs of pregnant smokers and might be useful complements to face-to-face smoking cessation support, but it is not clear how such digital interventions should be configured and delivered. Therefore, this study aimed to solicit HCPs' views regarding the use of digital smoking cessation interventions with pregnant women in order to inform the design and delivery of a new smartphone app to aid cessation during pregnancy. The following research questions were addressed:

1. How do HCPs view digital smoking cessation interventions in general?
2. How do HCPs view the potential of digital interventions to engage pregnant smokers with smoking cessation support?
3. What are the recommendations of HCPs for the content, design and mode of delivery of digital smoking cessation interventions for pregnant smokers?

8.3. Methods

8.3.1. Study design

Two structured qualitative focus groups were conducted at University College London in December 2012. The focus group design was chosen because it allowed the collection of detailed information on HCPs' views and attitudes, elaborated through discussion (Krueger, 2002, Finch and Lewis, 2003). Ethical approval for this study was obtained from the UCL Research Ethics Committee (Project ID: 4322/001). Informed consent was sought from participants, and confidentiality and anonymity were assured. Participants received no financial incentives, but lunch and refreshments were provided.

8.3.2. Participants

Participants were recruited from a network of HCPs who provided smoking cessation support for pregnant smokers in England. This network meets quarterly with organized speakers and workshop activities on topics of interest, and the focus group discussions were arranged for one of these meetings. One focus group was scheduled for the morning session of the meeting and one for the afternoon. The chair of the network sent the initial e-mail invitation to everyone on the network's mailing list (135 people), inviting them to attend the meeting and the focus groups, and subsequent email reminders were sent prior to the meeting. Of the 20 people who expressed interest in participating, 16 were available at the time the groups were convened (13 and 3 participants, respectively). These 16 individuals comprised HCPs, specialist stop smoking advisers for pregnancy (n=12) and specialist midwives for smoking

cessation (n=4), from 11 different NHS Trusts across London and South East England. Ten stop smoking advisers and three midwives participated in the first focus group, and two stop smoking advisers and one midwife in the second focus group. Table 18 shows the participants' characteristics.

Table 18: Background characteristics of health care providers participating in the focus groups in Study 5

	Total sample (n=16)
Age [a], Mean (SD); range	40.5 (8.5); 29-58
Female, % (n)	100 (16)
Current position, % (n)	
Specialist midwife for smoking cessation	25.0 (4)
Smoking cessation adviser	75.0 (12)
Working with pregnant smokers (in years), Mean (SD)	4.7 (2.7)
Number of pregnant smokers seen in a month, % (n)	
Up to 10	31.3 (5)
11-20	25.0 (4)
21-30	12.5 (2)
More than 30	18.8 (3)
Currently do not see pregnant smokers due to changes in role	12.5 (2)
Obtained NCSCT training certification, % (n)	93.8 (15)

[a] Not reported: n=2; NCSCT: National Centre for Smoking Cessation and Training

8.3.3. Measures

Prior to the main focus group discussion, participants completed a short demographic and

work-related questionnaire that asked their age, gender, position currently held, length of time working with pregnant smokers, average number of pregnant smokers seen monthly, and completion of the National Centre for Smoking Cessation and Training (NCSCT) (www.ncsct.co.uk) training programme. Data obtained from the questionnaires were used only for contextual understanding of the focus group discussions.

8.3.4. Procedure

During the main focus groups, a semi-structured interview schedule was followed (reported in Appendix E-8) to ensure that the same issues were covered in each group. The interview schedule was developed through discussions between Robert West, Lion Shahab and myself with a view to select a minimum set of questions that can cover a broad range of topics relevant to digital interventions. Additionally, in order to facilitate exploration of new ideas, open-ended questions were used. As a result, included questions addressed participants' views of digital smoking cessation interventions for pregnant smokers, and how these programmes might address the problems they face when providing face-to-face support for this population. Additionally, participants were asked to imagine that they were developing a highly-tailored website, smartphone app and text messaging service for pregnant smokers and then report what would seem important regarding content, format/delivery, and fitting to personal needs.

Finally, to facilitate the discussion, participants were guided through two previously developed digital smoking cessation interventions – the SF28 app (Ubhi et al., 2015) and the MumsQuit website (Herbec et al., 2014b) – and they were asked what they thought about the

programmes. However, given that participants did not have a chance to familiarize themselves with these programmes in detail, accounts that were specifically related to these digital interventions were not included in the analysis.

Each group session lasted approximately one hour and was designed and carried out in accordance with well-established focus group principles (Krueger, 2002, Krueger and Casey, 2009, Finch and Lewis, 2003). At the beginning of the discussion, participants were reminded that the aim was to explore HCPs' views on digital smoking cessation interventions as part of an ongoing process of developing a digital intervention for pregnant smokers, and that the discussions were audio-recorded and they had the right not to answer any questions and to withdraw at any time without giving a reason. Participants were encouraged to share both positive and negative comments with the group at all times, and they were asked to briefly introduce themselves to each other by saying their names and identifying the NHS Trust that employed them.

8.3.5. Analysis

Data were analysed thematically (Braun and Clarke, 2006) from a naïve realist epistemological position (Madill et al., 2000) (detailed in Chapter 7.3.5.). The focus group discussions were transcribed *verbatim*. A research assistant participating in the discussions and all HCPs were asked to provide feedback on the transcripts to ensure face validity. Transcripts were coded manually around both *a priori* and emergent themes, and a research assistant checked the coding for consistency. Where appropriate, data were assigned multiple codes and recurrent themes and sub-themes were identified in an iterative process. The list of

sub-themes identified in participants' *verbatim* accounts is reported in Appendix E-9. The coded data were then reviewed to identify: 1) HCPs' views of the potential value of using digital smoking cessation interventions with pregnant smokers; 2) HCPs' views of the potential limitations of using digital smoking cessation interventions with pregnant smokers; and 3) HCPs' recommendations for digital smoking cessation interventions for pregnant smokers. In presenting the findings, illustrative quotations were selected to represent core issues and an anonymised coding system (comprising each individual's study number and focus group) has been used to identify participants. Data analysis was conducted manually and no qualitative software was used.

8.3.6. Contributions

I conceived and designed this study, conducted the literature search and wrote up the interview schedule. I also conducted the focus group discussions, transcribed and analysed the data and wrote up the final study. Robert West and Lion Shahab contributed to the design and the write up of the study. Joanne Neale contributed to the data analysis and to the write up of the study. Milagros Ruiz assisted in the focus groups, provided feedback on the transcripts and assisted in the coding of the transcripts. Rachel Hastie and Emma Montero from the Pregnancy Network assisted in the recruitment of participants.

8.4. Results

8.4.1. Thematic analysis

There was no observable sign of any disagreements (either verbally or non-verbally) between participants in each focus group at any point during the discussions, and participants reached a consensus on different topics quickly. All themes but one were identified in both specialist midwives and stop smoking advisers' accounts. In terms of the recommendations for digital smoking cessation interventions for pregnant smokers, only stop smoking advisers contributed to the 'Tailoring of the messages' theme.

I. Potential value of using digital smoking cessation intervention

1. Anonymity for pregnant smokers

HCPs emphasised that a key benefit of delivering smoking cessation support via digital devices was the anonymity they afforded users. This could address pregnant smokers' reticence to declare their smoking status and engage those who were not interested in receiving face-to-face HCP support. Thus, HCPs reported that, although pregnant women tend not to participate in group behavioural support, they may be more likely to use peer-to-peer support in an anonymous online environment.

"I suppose for those who are struggling or those that want to admit their smoking without being judged, [a digital intervention] is great because it's like 'they don't know

what I actually look like', 'they're not gonna recognise me'. 'I'm just gonna be like maybe a number or I can maybe just give my first name'." (P3FG1, stop smoking adviser)

2. Increased reach of smoking cessation support

Increasing the reach of smoking cessation support was also consistently raised by HCPs as an important potential strength of digital smoking cessation interventions. First, digital interventions provided an alternative model of support that could attract greater numbers of pregnant smokers.

"If there is an alternative out there that works for maybe just a few per cent more that, either way, out of hours or it [the smoking cessation clinic] just doesn't work emotionally, then I think it's good to have many different types of models." (P2FG2, stop smoking adviser)

Secondly, digital interventions could offer easier access to support. In this regard, HCPs argued that pregnant smokers require a lot more time and effort to engage, particularly in terms of arranging the time and date of appointments, than smokers from the general population; therefore, digital interventions might reach those who struggle to attend face-to-face support because of travel and transport problems or lack of time. Thirdly, digital interventions might be attractive to a very wide range of women from pre-conception to postpartum, including teenagers, who do not attend any HCP support, do not return after their first appointment, or say that they do not want any help with smoking cessation.

"Because they may not come back, even though you think the first session has gone well, maybe because they managed to set a quit day or felt it a bit of a failure. I think you know, for someone who's failing that perhaps a digital route, the intervention, can be helpful." (P13FG1, stop smoking adviser)

3. Consistent quality of advice

The HCPs in the study noted that pregnant smokers are often misinformed about smoking and smoking cessation in pregnancy. In particular, they felt that pregnant smokers lacked knowledge about the effects of active and passive smoking on children's health, and that inconsistent messages about treatments were given to them by different health professionals. Consequently, HCPs felt that a digital intervention could serve as a much-needed source of consistent evidence-based information and a portal for accessing up-to-date research findings.

"If the midwife is saying and the GP is saying and the app has the same language, they're more likely to [use NRT]. So have a quite a unified message." (P2FG2, stop smoking adviser)

4. Availability on demand

A further benefit of digital smoking cessation interventions identified by the HCPs was its availability on demand. Digital interventions could provide ongoing motivational support for pregnant smokers because they could be delivered throughout pregnancy and postpartum and between face-to-face appointments. Being available any time also meant that digital aids

could play an important role in cravings management and in pre/postpartum relapse prevention.

> *"These women who have actually stopped, they need someone to keep saying they're doing well, so they just need to continue along the path without relapsing." (P2FG1, specialist midwife)*

Furthermore, digital programmes could offer more intensive support than face-to-face meetings because appointments were invariably time-limited.

> *"I think perhaps what I could personally do, but have less time to do, is lots of… follow up motivational [work], say text or things like that. I do, but it's quite client-dependent rather being a consistent thing." (P1FG2, stop smoking adviser)*

5. A supporting role for face-to-face treatment

One final potential benefit of digital smoking cessation interventions related to their ability to support face-to-face counselling. Thus, HCPs argued that linking digital programmes directly with smoking cessation clinics could both facilitate self-referral and initiate calls to smoking cessation advisers. Additionally, they thought that the quality of the initial assessment during face-to-face support might be enhanced if smokers could share their electronic data with the smoking cessation clinics. Ultimately, this might then reduce the costs associated with smoking cessation service provision.

"It [a digital intervention] can save the NHS loads of money. Because they could run alongside each other… You know, people we've seen weekly could then be seen fortnightly and then once a month… It could definitely be a money-saving." (P1FG1, specialist midwife)

II. Potential limitations of using digital smoking cessation interventions

6. Lack of access among those most economically disadvantaged

Unequal access to digital smoking cessation interventions across social groups was identified as a potentially important limitation to their use. Specifically, HCPs felt that people from lower socioeconomic groups would benefit less from this type of support, since they might not possess appropriate digital devices to access the programmes.

"A lot of my clients don't have Internet access, iPhones, you know. They are lucky if they have enough money to put electricity in their meter. So, you know, it's gonna be quite a large proportion of the society that you actually cannot target unless you have something like this in a pharmacy or a children's centre." (P4FG1, stop smoking adviser)

7. Need for high levels of self-motivation

Beyond this, HCPs highlighted the difficulties of engaging pregnant smokers with any type of smoking cessation support (e.g. leaflets, one-to-one or group support) and noted that this is because they tend to have low confidence in their own ability to stop smoking and be

motivated externally. Thus, HCPs commented that whilst digital aids were potentially attractive for pregnant smokers, they might in practice only be suitable for those who are highly motivated to stop smoking.

> *"I think the populations here that we can actually talk about, based on this intervention, is, you know, smokers who really want to quit and haven't got as many issues. So, a not so hard-to-reach population, will quit their own, and this might be perfect for them to just give them a bit of a motivation." (P11FG1, stop smoking adviser)*

8. Lack of human contact

In order for pregnant smokers to accept smoking cessation support and to explore women's underlying motivational forces to smoking, HCPs believed that they required a good rapport with their clients. To establish this, they stressed the importance of satisfying pregnant smokers' need to discuss other problems in their life (e.g. financial problems or relationship issues) during appointments, and noted that this would be hard to achieve through digital interventions.

> *"Sometimes you have to deal with all those other issues to get to smoking, and it's gonna be quite difficult using digital alone." (P4FG1, stop smoking adviser)*

Equally, HCPs argued that it was easier to establish intensive one-to-one support at the pregnant smoker's home, where the woman would feel secure. In consequence, the feasibility

of a standalone digital smoking cessation intervention without face-to-face support was questioned in both focus groups.

9. Inability to use expired-air CO monitoring

HCPs also stated that the inability to monitor pregnant smokers' progress and to validate their smoking status by expired-air CO monitoring was an important limitation of digital interventions, particularly as this raised problems in linking data to the quit targets of smoking cessation services. Furthermore, participants noted that CO monitoring would be missed not just as a validation but also as a motivational tool.

"Having the CO reading keeps them motivated as well, doesn't it? They can actually see the difference there. That would be missing." (P13FG1, stop smoking adviser)

10. Negative impact on smoking cessation medication

Finally, HCPs stressed that pregnant smokers have to be encouraged and supported to use NRT and were concerned that it would be more difficult for those engaging in digital smoking cessation interventions both to obtain medication and use it most effectively.

"Who is to check they're using their medication properly? They're over medicating or, as normal, they're under medicating… I'm really doubtful." (P1FG1, specialist midwife)

III. Recommendations for digital smoking cessation interventions

11. Content

In terms of content, HCPs felt that it was particularly important that digital smoking cessation interventions addressed a broad range of issues, including pregnant smokers' negative perceptions about smoking cessation support, second-hand-smoke exposure, cannabis use, relapse prevention, the short-term and long-term effects of smoking on children's health, the benefits of quitting smoking and that of being a non-smoker in the future.

> *"If I had a wish-list of what there should be on the texting message service, it'd be on the positive motivational supporters to what they've achieved and where they're at and what the future holds for them being a non-smoker." (P6FG1, stop smoking adviser)*

The ability of smoking cessation support to facilitate mothers' bonding with their babies was also deemed valuable.

> *"I think something that helps them making the connection with the baby as well. Sometimes it can be an issue with actually connecting to the baby. That's why they sort of cancel, because they haven't made that sort of connection. So this would be for them to focus on, you know, plugging away that this is what happens to your baby this week. All that sort of stuff that will help them to make that connection." (P1FG2, stop smoking adviser)*

In addition, participants in both focus groups emphasised that providing information about pharmacological support would be necessary and pregnant smokers' negative perceptions about NRT use, as well as their lack of knowledge about appropriate ways of using NRTs, would have to be addressed.

> *"So to make it clear that NRT is safe to use in pregnancy. The only thing you can't use is this, this, this. But having it really clear." (P3FG1, stop smoking adviser)*

12. Format and delivery

With regards to format and delivery, inclusion of a clear explanation regarding the nature of the support offered and how the digital smoking cessation programme worked were recommended. HCPs additionally argued that interventions should be easy to follow, provide interactivity, and contain more visuals than textual information.

> *"Things you can click on. Pictures are quite interactive. If you have lots of pictures and you can click on them to get to various points. Yeah, basically interactive." (P2FG2, stop smoking adviser)*

Further suggestions included enabling users to ask questions, receive daily tips (e.g. advice on changing their daily routines), and access the smoking cessation support in different languages. Other intervention features mentioned by HCPs included a saver calculator to help women monitor how much money they had saved by quitting smoking and a distraction game to help them cope with cravings.

"Just crossed my mind to have like a game add-on to it. 'Cos we're always talking about being bored, like 'bash the craving to head' sort of game." (P12FG1, stop smoking adviser)

Establishing an understanding environment with continuous support and encouragement around the digital intervention, and reassuring women that lapse and relapse are normal part of the process were also seen as pivotal.

"I think generally just keeping that person going and checking, I guess: 'Have you smoked?' 'No.' Then 'Great'… 'Congratulations' or a motivational feedback. If they have [smoked], more about: 'OK, it's not the end of the world. This happens.' You know, all sort of normalizing stuff, that again, we [HCPs] would do to help them getting back on track again." (P1FG2, stop smoking adviser)

Reflecting this, sending motivational messages, engaging women's partners, promoting smoking cessation clinics, and including the option of peer-to-peer support were viewed as likely to be useful, alongside providing positive reinforcements by means of collectable rewards (e.g. hearts, stars), incentives (e.g. vouchers), and congratulations for each smoke-free day.

"If they can have an online interface where they can have a chat to see how others are doing. To meet all these young girls who have [the] same experiences, struggles." (P12FG1, stop smoking adviser)

Importantly, however, HCPs noted that pregnant smokers should not be expected to send or reply to messages for extra support, and that they should be given supplementary motivational messages around their quit date.

13. Tailoring of the messages

In terms of tailoring support to personal needs, HCPs stated that women's preferences for the frequency, number and timing of motivational messages should be taken into account and confidentiality should be respected – with support still provided for those who did not want to declare any of their personal details. In particular, individualised messages, which included the pregnant woman's name, motivations and reasons for stopping smoking, were considered likely to enhance the success of the intervention. It was recommended that the programme should continuously monitor and record women's self-reported smoking status, levels of motivation, confidence and cravings. These could then provide the basis to further personalise messages in order to meet each individual smoker's needs.

> *"That can be something they could do, not necessarily every day but every few days, just like you know, 'Out of ten, whatever, where is your motivation at?'. Just sort of to see and if it starts to drop, then 'Oh, you can see your motivation dropped, what can we do about that?' Because we know that it actually happens. It may be about confidence as well. You know, if they have smoked, what was that about? You know what I mean? Just keeping a track of that, and having a motivational thing at that point." (P1FG2, stop smoking adviser)*

Table 19 reports a list of recommendations for the design and delivery of a smartphone app for pregnant smokers, including specific aspects of the content (e.g. information provision and skills improvement), format and delivery (e.g. duration of support and functioning), and tailoring of the messages (e.g. personalization and frequency of messages).

Table 19: Recommendations for the design and delivery of a smartphone app for pregnant smokers as identified by health care providers in Study 5

Intervention characteristics	**Specific aspects**	**Implications for intervention development and design**
Content	Information provision and increase motivation to stop smoking	Provide information about the short-term and long-term health effects of smoking during pregnancy.
		Provide information about the health consequences of passive smoking after birth.
		Provide information about the benefits of stopping smoking.
		Provide information about how to use nicotine replacement therapy during pregnancy.
		Provide information about the health consequences of cannabis use.
		Increase salience of a future non-smoker identity.
		Foster mothers' emotional bonding with their babies.
	Promote adjunctive behaviours	Promote the use of nicotine replacement therapy.
		Promote uptake of smoking cessation support.
	Skills improvement	Improve pregnant smokers' skills to cope with cravings.
Format and delivery	Duration of support	Provide ongoing support.
		Provide additional motivational messages around the individual's selected quit date.
	Design	Intervention should be easy to follow.
		Provide more visuals than textual information.
		Provide information in a format of 'daily tips'.
	Functioning	Send behaviour change messages automatically.
		Provide interactive intervention features.

Intervention characteristics *(continued)*	**Specific aspects**	**Implications for intervention development and design**
Format and delivery	Functioning *(continued)*	Provide smoking cessation support in different languages. Include a built-in saver calculator to monitor how much money individual's save by quitting. Include a built-in distraction game to help pregnant women cope with cravings. Include the option of peer-to-peer support. Include collectable rewards and incentives as forms of positive reinforcements. Provide easy access to face-to-face support. Enable pregnant smokers to ask questions. Engage with pregnant smokers' partner. Provide tutorials to explain how the intervention operates.
Tailoring of messages	Personalization	Address individuals by their name if they agreed to it. Individualise messages to pregnant smokers' current level of motivation to stop. Individualise messages to pregnant smokers' reasons to stop. Provide complete anonymity for users.
	Frequency and timing	Tailor the frequency and timing of motivational messages to individuals' preferences.
	Monitoring and feedback	Monitor individuals' smoking status and provide personalised feedback on progress. Monitor individuals' motivation to stop and provide personalised behaviour change messages. Monitor individuals' confidence in ability to stop smoking and provide personalised behaviour change messages. Monitor individuals' level of cravings and provide personalised behaviour change messages.

8.5. Discussion

HCPs indicated that digital interventions offer a range of potential benefits that could make them useful for pregnant smokers, such as providing anonymity, offering consistent quality of advice, and being available on demand. However, important limitations need to be considered and addressed, including the lack or limited access among pregnant women from low socioeconomic groups, the need for high levels of self-motivation, and the lack of human contact with an expert stop smoking adviser. In terms of the design and delivery of digital smoking cessation interventions for pregnant smokers, HCPs recommended that future interventions should address pregnant smokers' negative perceptions of face-to-face smoking cessation support, they should provide rewarding experiences for the users, and the intervention content should be tailored to smokers' level of confidence to quit smoking.

Findings from this study suggest that digital smoking cessation interventions may help to overcome the barriers to accessing face-to-face smoking cessation support, as previously noted by service providers (Abatemarco et al., 2007, Price et al., 2006, Tappin et al., 2010) and pregnant women (Ussher et al., 2006, Ingall and Cropley, 2010, Herberts and Sykes, 2012), and which is also consistent with the findings from Study 4 in this thesis (Chapter 7.4.). Moreover, and also in line with the literature and Study 4, HCPs identified that convenience (Naughton et al., 2013b, Herbec et al., 2014a), anonymity (Szwajcer et al., 2005), the provision of information over and above HCP support (Huberty et al., 2013) and the provision of instant tips and advice to cope with cravings (Herbec et al., 2014a) could be important in motivating pregnant women to seek health information via digital sources.

One of the main limitations of using digital interventions identified in the focus groups related to poor access to technology amongst women from lower socioeconomic groups. Although disparities between ethnic groups in overall internet use and seeking online smoking cessation information/support have been reported (Laz and Berenson, 2013), studies from different countries have consistently found that the majority of pregnant women have access to the internet and actively use this channel to seek health information (Huberty et al., 2013, Larsson, 2009, Gao et al., 2013, Davis et al., 2014). Additionally, the penetration of the internet is growing rapidly, and the general trend indicates that the proportion of people who use their phones as a primary device to access to the internet is also increasing (International Telecommunication Union, 2014). Nevertheless, despite many potential benefits of using digital interventions, our findings support previous studies in the literature (Naughton et al., 2013b, Herbec et al., 2014a) and Study 4 (Chapter 7.4.) in that it is still necessary to provide pregnant women with the option of speaking to someone face-to-face, whereby they can benefit from the use of additional motivational tools, such as CO monitoring.

Significantly, findings from this study showed good concordance with the potential intervention targets identified in the COM-B analysis in Study 4 (Chapter 7.4.) and the BCTs used in effective behavioural support for smoking cessation, as a number of the recommendations on specific intervention components made within the focus groups referred directly to BCTs. For example, giving advice on and facilitating the use of social support, facilitating relapse prevention, providing rewards contingent on successfully stopping smoking and providing information on the consequences of smoking and smoking cessation are already evidence-based for specialist pregnancy behaviour support for smoking cessation (Lorencatto et al., 2012). Giving advice on pharmacotherapy and giving advice on changing

routine is evidence-based for generic smoking cessation behavioural support (Michie et al., 2011c, West et al., 2010). Giving advice on identity and facilitating the establishment of a new non-smoker identity was identified both by pregnant smokers (reported in Study 4 in Chapter 7.4.) and HCPs.

From the perspective of HCPs, future digital smoking cessation interventions for pregnant smokers need to establish a positive atmosphere with continuous support and rewarding experiences to increase women's motivation and confidence in stopping smoking. Emphasis should also be placed on providing social support and addressing women's negative preconceptions regarding medication use and face-to-face support, as well as increasing their awareness of the health consequences of smoking and quitting. A digital intervention targeted at pregnancy could potentially support women in bonding with their babies and also provide opportunities for monitoring and receiving feedback on their smoking cessation progress. Ideally, digital interventions should complement, rather than replace, face-to-face smoking cessation support in pregnancy. Future research is needed to advance knowledge of the role particular BCTs delivered in digital interventions play in intervention usage and effectiveness.

8.5.1. Limitations

This study has a number of limitations. First, it had a small sample size, as only 20 of the 135 people approached regarding the focus groups responded and 16 participated in the study. Moreover, those who took the time to participate may therefore have been motivated by especially positive or negative personal views (perhaps seeing digital interventions as an

exciting innovation or conversely as a threat to their professional expertise). However, mitigating these concerns, participants were recruited from a large geographic region, had diverse demographic characteristics, and did not give any impression of biased or extreme views in the focus group discussions.

CHAPTER 9 – BEHAVIOUR CHANGE TECHNIQUES IN A SMOKING CESSATION WEBSITE TO AID CESSATION DURING PREGNANCY (STUDY 6)

9.1. Abstract

Specifying the active components of complex interventions can inform the development of new interventions. This study applied the BCTTv1 to characterise the content of a pregnancy-specific smoking cessation website by BCTs. More tentatively it explored whether exposure to specific BCTs might be associated with quit success. Data from 99 pregnant smokers (age 18 and over) who received cessation support through the MumsQuit website were included. Demographic and smoking-related characteristics, and self-reported four-week continuous abstinence at eight weeks follow-up were assessed. The number of logins and pages viewed were automatically recorded. Intervention pages were coded by BCTs, and participants' BCT exposures were calculated. The mean number of logins and pages viewed were significantly lower in low socioeconomic groups than in high socioeconomic groups. Of 841 BCT instances, 39 distinct BCTs were coded. On average, participants were exposed to 54.1 BCTs (SD=74.1) and 12.6 distinct BCTs (SD=9.3). In the univariable logistic regressions, six BCTs were associated with abstinence, such as 'problem solving', 'feedback on behaviour', and 'self-monitoring of outcomes of behaviour'. However, it was not feasible to evaluate the independent effects of BCTs. This study concludes that pregnant smokers, especially from low socioeconomic groups, were exposed to a small proportion of intended BCTs in the MumsQuit website. A number of potential BCTs were identified as high priority for inclusion in digital interventions for pregnant smokers to evaluate their effectiveness experimentally.

9.2. Introduction

Digital smoking cessation interventions are considerably heterogeneous in terms of effectiveness, and as their content is often poorly reported, little is known about what may cause their effects or why interventions fail to bring about behaviour change (Civljak et al., 2013, Michie and Aberdeen, 2012). Moreover, these interventions are typically complex owing to a number of components with a potential to influence the behavioural outcome (Craig et al., 2008); consequently, even if the interventions were reported transparently, it would require a systematic and standardized method to describe the content and evaluate the effectiveness of individual intervention components (Abraham and Michie, 2008). Identifying BCTs in complex interventions has been deemed a reliable method for specifying their content (Michie et al., 2011a), and it has been used to advance knowledge of components that are most likely to constitute effective behaviour change interventions in various fields, such as smoking (West et al., 2010), alcohol consumption (Michie et al., 2012c), physical activity (Currie et al., 2013) or healthy eating (Lara et al., 2014). However, no study has examined this in digital smoking cessation interventions for pregnant smokers.

A BCT, such as providing feedback on the person's behaviour, is the smallest unit of observable and replicable active ingredients of behaviour change interventions, which can be used alone or in combination with other BCTs in order to alter a behaviour or behavioural pattern (Michie et al., 2011c). Specifying BCTs in behaviour change interventions lays the foundation for understanding the mechanisms of intervention effects, implementing and replicating interventions accurately, accumulating evidence of effective BCTs and using those BCTs to develop new interventions (Michie et al., 2013a). Various taxonomies have

been proposed in recent years to provide frameworks for characterizing BCTs in behaviour change interventions for improving physical activity and healthy eating (Abraham and Michie, 2008, Michie et al., 2011b), smoking cessation (Michie et al., 2011c, Michie et al., 2012b, West et al., 2011), and reducing alcohol consumption (Michie et al., 2012c). More recently, a comprehensive taxonomy – the BCTTv1 – has been developed to be used across behavioural domains (Michie et al., 2013a). It encompasses 93 BCTs grouped into 15 clusters according to their core function in bringing about behaviour change, such as feedback and monitoring, social support, regulation and identity (Michie et al., 2013a).

Different methods can be used to evaluate the effectiveness of BCTs, including systematic reviews and meta-analyses (Lara et al., 2014, Currie et al., 2013), meta-CART analyses (Dusseldorp et al., 2014), factorial experiments (Wyrick et al., 2014, Collins et al., 2011) and correlational studies (West et al., 2010, West et al., 2011). The latter for example has been used to assess the associations between BCTs identified in treatment manuals for generic smoking cessation support of the English stop smoking services and four-week success rates of the services (West et al., 2010, West et al., 2011). Applying smoking-specific taxonomies (Michie et al., 2011c, West et al., 2011), these studies found that nine BCTs (e.g. 'strengthening ex-smoker identity') were associated with both self-reported and CO-verified abstinence (West et al., 2010), eight BCTs (e.g. 'boosting motivation and self-efficacy') were associated with either self-reported or CO-verified abstinence (West et al., 2010), and two BCTs delivered in group support (e.g. 'placing a financial deposit which is lost if a stop-smoking buddy relapses') were associated with self-reported abstinence (West et al., 2011).

Evidence on effective BCTs for interventions to help pregnant smokers stop smoking is

scant. One study has reported that 11 BCTs (e.g. 'providing rewards contingent on successfully stopping smoking') were identified in the descriptions of evidence-based face-to-face behavioural support for pregnant smokers (Lorencatto et al., 2012); however, the effectiveness of individual BCTs independent of potential confounders, such as pre-existing motivation or use of cessation aids, has not been evaluated. Neither is it known which BCTs would be useful for inclusion in cessation support utilizing different modes of delivery, such as websites or smartphone apps. Moreover, it is possible that there is a bi-directional relationship between exposure to BCTs in digital interventions and abstinence; consequently, an effective BCT may result in longer abstinence, and so greater exposure to the intervention content as a whole. This is because of the positive association between engagement with digital interventions and abstinence (Ubhi et al., 2015). Therefore, it would probably require experimental research design to disentangle the specific effects of BCTs within interventions. Nevertheless, a better understanding of how these issues manifest in digital interventions for pregnant smokers could form the basis for further evaluation.

Only a handful of digital interventions have been developed for pregnant smokers, and none of them have been systematically characterised by BCTs. MumsQuit is an interactive smoking cessation website to provide automated support for pregnant smokers (Herbec et al., 2014b). It was developed as a pilot pregnancy adaptation of a generic smoking cessation website, StopAdvisor (Michie et al., 2012a), which has been found to improve long-term quit rates among smokers from low socioeconomic groups (Brown et al., 2014). Fundamental characteristics of these interventions include that both promote complete smoking cessation on the basis of empirical evidence, principles from PRIME theory (West and Brown, 2013, West, 2006b) and 33 BCTs from the smoking taxonomy (Michie et al., 2011c). StopAdvisor

was developed using 'LifeGuide', an open-source web development platform (Hare et al., 2009), which allowed a relatively easy adaptation of the structure, design and content of the original intervention to MumsQuit; therefore, only minimal changes were implemented to tailor the content to pregnancy (Herbec et al., 2014b). A pilot RCT showed that 28% of pregnant smokers in MumsQuit achieved self-reported short-term abstinence compared with 21% allocated to a control website (OR=1.5; 95% CI=0.8-2.9; p=0.220) (Herbec et al., 2014b), but the potential active components in MumsQuit are yet to be investigated.

9.2.1. Aims and research questions

Overall, previous studies have identified a number of BCTs as evidence based for smoking cessation behavioural support, but no study has specified BCTs in digital interventions for pregnant smokers, and it is not clear which BCTs delivered in this way might be associated with quit success during pregnancy. Therefore, this study aimed to characterise the content of the MumsQuit smoking cessation website, and as a preliminary assessment, it aimed to explore the associations between pregnant smokers' exposure to specific BCTs and short-term abstinence. The following research questions were addressed:

1. What demographic and smoking-related characteristics are associated with pregnant smokers' engagement with the MumsQuit smoking cessation website?
2. Which BCTs from a comprehensive taxonomy can be identified in the MumsQuit intervention?
3. What are the associations between pregnant smokers' exposure to specific BCTs in MumsQuit and abstinence at eight weeks follow-up?

9.3. Methods

9.3.1. Study design

This study used data that were collected in a two-arm double-blind pilot randomised controlled trial of a smoking cessation website for pregnant smokers (Herbec et al., 2014b). Participants were recruited through an online advertisement placed on the NHS smokefree website (https://quitnow.smokefree.nhs.uk), and those who provided consent to participate in the study were randomly allocated to receive fully automated smoking cessation support through an interactive tailored website (MumsQuit) or a non-tailored static website (control condition). Supplemental face-to-face support was not provided. Data that were collected in the MumsQuit intervention arm were included in this study. Participants did not receive compensation for participation. Ethical approval was obtained from the UCL Research Ethics Committee (Project ID: 3556/002).

9.3.2. Participants

Participants were recruited between March 2012 and October 2013 through the English Department of Health's SmokeFree website (www.nhs.uk/smokefree), other pregnancy-related websites and online discussion forums in the UK. Pregnant women aged 18 and over who were from the UK, smoked cigarettes every day and were prepared to make a serious attempt to quit smoking within a month were eligible to participate in the trial (Herbec et al., 2014b). A total of 99 participants were randomly assigned to the MumsQuit intervention arm. Of these, 63 (63.6%) completed the follow-up assessment at eight weeks post enrolment.

9.3.3. Measures

Prior to the first intervention session, participants' were asked about their age and occupationally-based socioeconomic status, which was measured according to the UK National Statistics Socio-Economic Classification (NS-SEC) (Office for National Statistics, 2010). Occupational categories were combined to correspond to the classification system used in previous chapters (Chapters 4.3.3., 5.3.3. and 7.3.3.), as follows. ABC1 referred to those with higher and intermediate professional/managerial, supervisory, clerical, junior managerial/administrative/professional occupations; and C2DE referred to those with skilled, semi-skilled and unskilled manual, and lowest grade occupations, or unemployed. Moreover, participants were asked about their pregnancy status ('first trimester', 'second trimester', 'third trimester'), and if they had made a serious quit attempt in the past year ('How long ago was your most recent serious attempt to stop? – 'Less than one year', 'A year or more ago', 'Not made one'). Nicotine dependence was assessed by using the HSI (details of this measure are discussed in Chapter 4.3.3.) (Heatherton et al., 1989).

At eight weeks post enrolment, self-reported four-week continuous abstinence was assessed online ('Have you smoked at all in the past four weeks?' – 'Yes' or 'No') or over the phone if participants did not complete the online questionnaire. Quantitative indices of engagement with the website, including the total number of logins each participant accumulated and the number of times they viewed each page in MumsQuit, were automatically collected.

Participants' exposure to BCTs was calculated as follows. Intervention pages in MumsQuit were linked with the BCTs that were identified in their content. Each BCT was counted only

once per page. Individuals' exposure to specific BCTs was determined using data on the intervention pages the person viewed and multiplied by the number of times she viewed a particular page.

9.3.4. Intervention

The intervention structure in MumsQuit was the same as in StopAdvisor (Michie et al., 2012a); therefore, pregnant smokers were directed through a quit plan, according to which tailored support was offered throughout the smoking cessation process up to four weeks before and after their selected quit date. The behaviour change content was delivered in interactive menus, whereby participants could freely choose from different topics (e.g. information about cigarette addiction or relaxation exercises), and through a series of tunnelled intervention sessions, in which participants had to navigate the site in a set order. A maximum of 18 automated smoking cessation sessions were offered, which were divided between pre-quit (a minimum of three and a maximum of five sessions) and post-quit sessions (a maximum of 13 sessions). Email reminders about the scheduled sessions were sent to participants to invite them back to the website. Additionally, participants were encouraged to log in MumsQuit any time when they felt that they would need further information or help with their quit attempt.

Pre-quit sessions were tailored to pregnant smokers' selected quit date, intended use of NRT, success in obtaining and using NRT, and reasons for quitting. These sessions provided information primarily about withdrawal symptoms, NRT use and how to obtain it, and participants were given advice to set and prepare for their quit date (e.g. making changes in

routines) and to minimize urges to smoke (e.g. establishing adequate coping strategies). Post-quit sessions were tailored to participants' smoking status, urges to smoke, confidence in ability to remain abstinent, use of NRT and anticipated frequency of stressful events or social situations. Depending on their self-report, information and advice were provided to address these issues in order to help them maintain abstinence and overcome potential barriers to quitting, such as by boosting their self-efficacy or by giving them advice on how to cope with stress. Beyond these, fostering a new identity as a non-smoker was important both in pre-quit and post-quit sessions.

9.3.5. Procedure

The content of MumsQuit was derived from a dedicated LifeGuide website (http://lifeguide.north-51.com:8280/player/view/mumsquit – the site is no longer available as the research project has ended), which was originally used to develop the intervention. Screenshots were taken of all 645 pages of the intervention as they were presented to participants, excluding recruitment pages and baseline questionnaire, and the BCTTv1 (Michie et al., 2013a, Michie et al., 2011a) was applied to identify BCTs in the content of each page. Intervention pages with all identified BCTs were recorded in an Excel spreadsheet, and the reliability of coding was assessed with a second coder (Aleksandra Herbec) who independently identified BCTs in a subset of pages (n=530; 82.2%). There was a 78% agreement between the two coders, who previously completed a BCT coding training and followed established guidelines to identify BCTs using the BCTTv1. A BCT was coded as present if: 1) the text on a webpage corresponded to definitions provided in the aforementioned taxonomy, and 2) a BCT related to the behaviour change target of the

MumsQuit intervention (i.e. stopping smoking). If a page contained more than one BCT, all were identified and coded once per page. If the text did not contain any identifiable BCTs, the page was labelled as 'no BCT'. When both coders agreed that a BCT was present (or absent) on a given page, it was registered as inter-coder agreement; otherwise, disagreement was recorded and the first coder's BCT coding was included in the analysis.

9.3.6. Analysis

To compare baseline characteristics of those who were followed up and those who were not followed up at eight weeks, and to assess the associations between participants' demographic and smoking characteristics and engagement with MumsQuit in terms of the number of logins and pages viewed, Pearson's χ^2 and t-tests were used for categorical and continuous variables, respectively. Correlation coefficients were calculated to assess associations between continuous variables. Univariable and multivariable logistic regression analyses were conducted to examine the associations between exposure to specific BCTs and self-reported four-week continuous abstinence at eight weeks follow-up, with and without adjusting for other covariates.

9.3.7. Contributions

Jamie Brown and Aleksandra Herbec recruited participants and gathered data in the MumsQuit pilot RCT. I conceived and designed this study, conducted the literature search, coded the intervention by BCTs, analysed the data and wrote up the final study. Robert West,

Lion Shahab and Jamie Brown contributed to the design and the write up of the study. Aleksandra Herbec assisted in the BCTs coding.

9.4. Results

9.4.1. Associations between participants' background characteristics and engagement with MumsQuit

Table 20 reports the background characteristics of participants at baseline and at eight weeks follow-up, and the associations between baseline characteristics and engagement with MumsQuit. There were no significant differences in background characteristics between those who were followed up and who were lost to follow-up at eight weeks post enrolment. Overall, the mean number of logins was 3.5 (SD=4.5; median=2; range: 1-18), 47.5% of women logged in MumsQuit once, and participants viewed a mean of 59.4 intervention pages (SD=78.5; median=30; range: 3-358). In terms of the associations between pregnant smokers' demographic and smoking characteristics and the extent to which they engaged with the intervention, participants from low socioeconomic groups logged in less often and viewed fewer pages than women from high socioeconomic groups. Other associations were not found to be statistically significant.

Table 20: Background characteristics of pregnant smokers participating in the MumsQuit intervention at baseline and at eight weeks follow-up, and associations between background characteristics and engagement with the website in Study 6

	Total sample at baseline (n=99)	Lost to follow-up at eight weeks (n=36)	Followed up at eight weeks (n=63)	Engagement with the MumsQuit website (N of participants=99)			
				Number of logins		Number of pages viewed	
				Mean (SD)	Correlation coefficient/t-test; p-value	Mean (SD)	Correlation coefficient/t-test; p-value
Age, Mean (SD)	27.6 (6.0)	26.1 (6.5)	28.4 (5.7)		r=0.19; p=0.059		r=0.18; p=0.074
Social grade, % (n)							
ABC1	45.5 (45)	36.1 (13)	50.8 (32)	5.3 (5.9)	t(50.6)=-3.56;	92.6 (101.7)	t(51.7)=-3.84;
C2DE	54.5 (54)	63.9 (23)	49.2 (31)	2.0 (1.8)	p=0.001	31.8 (33)	p<0.001
Pregnancy trimester, % (n)							
First	76.8 (76)	75.0 (27)	77.8 (49)	3.5 (4.4)	t(97)=-0.21;	59.1 (79.5)	t(97)=-0.06;
Second or third	23.2 (23)	25.0 (9)	22.2 (14)	3.7 (4.9)	p=0.837	60.3 (76.6)	p=0.951
Heaviness of Smoking Index, Mean (SD)	2.9 (1.1)	2.8 (1.0)	3.0 (1.1)		r=-0.09; p=0.367		r=-0.05; p=0.654
Quit attempts in the past year, % (n)							
No quit attempt	62.6 (62)	55.6 (20)	66.7 (42)	3.8 (4.7)	t(97)=0.71;	65.2 (85.3)	t(97)=0.94;
Quit attempt	37.4 (37)	44.4 (16)	33.3 (21)	3.1 (4.3)	p=0.479	49.8 (65.6)	p=0.348

9.4.2. Behaviour change techniques identified in MumsQuit

Of 645 intervention pages in MumsQuit, 517 (80.2%) contained identifiable BCTs. Table 21 reports the list of BCTs identified, the number of pages containing a particular BCT and the number of participants who were exposed to BCTs. Of possible 93 BCTs grouped into 16 BCT clusters in the BCTTv1, MumsQuit delivered 39 distinct BCTs (41.9% of all BCTs) that mapped on to 15 BCT clusters. No BCT was identified from the '14. Scheduled consequences' cluster (therefore omitted from the table). In total, 841 BCT instances were coded with a mean of 1.6 BCTs per page (SD=0.9; median=1; range: 1-7). Each BCT was identified in the content of 22 pages on average (median=9; SD=46.2; range=1-284).

The five most frequently identified BCTs were 'pharmacological support' (54.9% of pages), 'information about health consequences' (12.6% of pages), 'social reward' (11.4% of pages), 'identity associated with changed behaviour' (9.1% of pages) and 'social comparison' (8.7% of pages). The least frequently identified BCTs were 'feedback on outcomes of behaviour', 're-attribution', 'monitoring of emotional consequences', 'information about others' approval', 'prompts/cues', 'self-incentive' and 'restructuring the physical environment', all of which were identified once (0.2% of pages, respectively). BCTs that most participants were exposed to at least once included 'information about health consequences' (92.9% of participants), 'pharmacological support' (91.9% of participants), 'credible source' (90.9% of participants), 'framing/reframing' (89.9% of participants), 'information about social and environmental consequences' (88.9% of participants), and information about others' approval' (88.9% of participants). No participant was exposed to the 're-attribution', 'prompts/cues' and 'self-incentive' BCTs.

Table 21: Identified behaviour change techniques (BCTs) with related BCT clusters, number of intervention pages and number of participants exposed to particular BCTs in MumsQuit in Study 6

BCT clusters [a]	BCTs [a] identified in MumsQuit	Percentage of pages including BCTs (N of pages=517) [b]	Percentage of participants exposed to BCTs (N of participants=99)
1. Goals and planning	1.1 Goal setting (behaviour)	4.4 (23)	59.6 (59)
	1.2 Problem solving	1.5 (8)	17.2 (17)
	1.3 Goal setting (outcome)	0.4 (2)	59.6 (59)
	1.4 Action planning	3.9 (20)	24.2 (24)
	1.9 Commitment	1.7 (9)	23.2 (23)
2. Feedback and monitoring	2.2 Feedback on behaviour	2.3 (12)	15.2 (15)
	2.3 Self-monitoring of behaviour	2.9 (15)	22.2 (22)
	2.4 Self-monitoring of outcome(s) of behaviour	0.4 (2)	18.2 (18)
	2.7 Feedback on outcome(s) of behaviour	0.2 (1)	15.2 (15)
3. Social support	3.1 Social support (unspecified)	6.4 (33)	59.6 (59)
4. Shaping knowledge	4.2 Information about antecedents	1.0 (5)	16.2 (16)
	4.3 Re-attribution	0.2 (1)	0
5. Natural consequences	5.1 Information about health consequences	12.6 (65)	92.9 (92)
	5.3 Information about social and environmental consequences	8.1 (42)	88.9 (88)
	5.4 Monitoring of emotional consequences	0.2 (1)	4.0 (4)
	5.6 Information about emotional consequences	3.5 (18)	67.7 (67)
6. Comparison of behaviour	6.2 Social comparison	8.7 (45)	46.5 (46)
	6.3 Information about others' approval	0.2 (1)	88.9 (88)
7. Associations	7.1 Prompts/cues	0.2 (1)	0
8. Repetition and substitution	8.2 Behaviour substitution	1.4 (7)	18.2 (18)
9. Comparison of outcomes	9.1 Credible source	4.3 (22)	90.9 (90)

BCT clusters [a] *(continued)*	BCTs [a] identified in MumsQuit	Percentage of pages including BCTs (N of pages=517) [b]	Percentage of participants exposed to BCTs (N of participants=99)
10. Reward and threat	10.4 Social reward	11.4 (59)	24.2 (24)
	10.7 Self-incentive	0.2 (1)	0
	10.9 Self-reward	3.5 (18)	11.1 (11)
11. Regulation	11.1 Pharmacological support	54.9 (284)	91.9 (91)
	11.2 Reduce negative emotions	3.7 (19)	18.2 (18)
	11.3 Conserving mental resources	0.4 (2)	11.1 (11)
12. Antecedents	12.1 Restructuring the physical environment	0.2 (1)	20.2 (20)
	12.2 Restructuring the social environment	0.6 (3)	7.1 (7)
	12.3 Avoidance/reducing exposure to cues for the behaviour	2.1 (11)	22.2 (22)
	12.4 Distraction	2.1 (11)	17.2 (17)
	12.6 Body changes	1.2 (6)	3.0 (3)
13. Identity	13.1 Identification of self as role model	1.4 (7)	17.2 (17)
	13.2 Framing/reframing	0.8 (4)	89.9 (89)
	13.5 Identity associated with changed behaviour	9.1 (47)	49.5 (49)
15. Self-belief	15.1 Verbal persuasion about capability	2.5 (13)	11.1 (11)
	15.3 Focus on past success	1.7 (9)	12.1 (12)
16. Covert learning	16.1 Imaginary punishment	1.2 (6)	10.1 (10)
	16.2 Imaginary reward	1.4 (7)	12.1 (12)

[a] BCT clusters and BCTs were identified using the Behaviour Change Taxonomy v1 (Michie et al., 2011a, Michie et al., 2013a); [b] More than one distinct BCT could be identified in the content of any given intervention page.

9.4.3. Pregnant smokers' exposure to behaviour change techniques

Overall, participants were exposed to a mean of 54.1 BCTs (SD=74.1; median=27; range: 0-320). Of 39 distinct BCTs identified, participants were exposed to 12.6 distinct BCTs on average (SD=9.3; median=10; range: 0-34). Four participants did not view any intervention pages with identifiable BCTs. As would be expected, those who were followed up were exposed to significantly more BCTs than those who were lost to follow-up at eight weeks (M=71.7, SD=87.7 vs. M=23.3, SD=15.4; t(68.5)=-4.26; p<0001).

Table 22 reports the logistic regression analyses to assess the relationships between specific BCTs and four-week continuous abstinence at eight weeks follow-up. In the univariable analyses, exposure to six BCTs, including 'problem solving', 'feedback on behaviour', 'self-monitoring of outcomes of behaviour', 'feedback on outcomes of behaviour', 'social reward' and 'self-reward', were associated with abstinence. To assess collinearity, correlation coefficients were calculated between BCT exposures and engagement with the website by means of the number of logins, and as expected, there were strong correlations between the variables (results are not reported due to the extensive dimensions of the correlational matrix). After adjusting for the number of logins, there were significant negative associations between 'goal setting (behaviour)', 'social support (unspecified)', 'pharmacological support', and 'framing/reframing' and abstinence (Table 22).

Table 22: Associations between exposure to behaviour change techniques (BCTs) and smoking abstinence at eight weeks follow-up in Study 6

BCTs [a] identified in MumsQuit	Follow-up at eight weeks (N of participants=63)		
	Participants' exposure to BCTs	Four-week continuous abstinence	
	Mean (SD), range	OR (95% CI); p-value	Adj. OR [b] (95% CI); p-value
1.1 Goal setting (behaviour)	1.2 (1.3), 0-5	0.88 (0.59-1.31); p=0.528	0.45 (0.23-0.87); p=0.018
1.2 Problem solving	0.4 (0.7), 0-3	2.45 (1.02-5.87); p=0.045	1.64 (0.44-6.10); p=0.462
1.3 Goal setting (outcome)	1.4 (1.1), 0-5	1.05 (0.67-1.64); p=0.839	0.73 (0.42-1.27); p=0.264
1.4 Action planning	2.4 (4.0), 0-13	1.12 (0.98-1.28); p=0.088	0.89 (0.61-1.29); p=0.541
1.9 Commitment	0.7 (1.4), 0-6	0.98 (0.68-1.43); p=0.933	0.41 (0.16-1.01); p=0.053
2.2 Feedback on behaviour	1.8 (4.3), 0-18	1.26 (1.12-1.56); p=0.035	1.31 (0.93-1.87); p=0.126
2.3 Self-monitoring of behaviour	2.4 (4.8), 0-16	1.11 (1.00-1.25); p=0.066	0.98 (0.76-1.27); p=0.875
2.4 Self-monitoring of outcome(s) of behaviour	4.2 (8.6), 0-28	1.08 (1.01-1.16); p=0.030	1.06 (0.92-1.23); p=0.394
2.7 Feedback on outcome(s) of behaviour	0.8 (1.7), 0-6	1.76 (1.07-2.89); p=0.026	2.01 (0.89-4.53); p=0.094
3.1 Social support (unspecified)	3.2 (3.7), 0-13	1.02 (0.89-1.17); p=0.794	0.65 (0.45-0.92); p=0.017
4.2 Information about antecedents	0.5 (1.0), 0-4	1.15 (0.69-1.92); p=0.585	0.54 (0.23-1.29); p=0.166
4.3 Re-attribution	0	-	-
5.1 Information about health consequences	7.8 (8.6), 0-40	1.07 (1.00-1.15); p=0.059	1.02 (0.91-1.15); p=0.717
5.3 Information about social and environmental consequences	4.1 (5.9), 0-28	1.08 (0.99-1.19); p=0.098	1.00 (0.86-1.16); p=0.950
5.4 Monitoring of emotional consequences	0.1 (0.3), 0-1	0.40 (0.04-4.02); p=0.433	0.11 (0.01-1.54); p>0.999
5.6 Information about emotional consequences	2.4 (2.4), 0-12	1.08 (0.88-1.33); p=0.454	0.80 (0.57-1.12); p=0.201
6.2 Social comparison	2.8 (5.2), 0-21	1.11 (0.99-1.25); p=0.066	1.04 (0.88-1.22); p=0.659
6.3 Information about others' approval	1.0 (0.4), 0-3	0.17 (0.02-1.38); p=0.098	0.13 (0.02-1.16); p=0.067
7.1 Prompts/cues	0	-	-
8.2 Behaviour substitution	0.5 (1.0), 0-4	1.61 (0.94-2.77); p=0.084	1.03 (0.44-2.45); p=0.942
9.1 Credible source	3.8 (3.4), 0-16	1.09 (0.93-1.26); p=0.288	1.03 (0.87-1.21); p=0.757

BCTs [a] identified in MumsQuit *(continued)*	Follow-up at eight weeks (N of participants=63)		
	Participants' exposure to BCTs	Four-week continuous abstinence	
	Mean (SD), range	OR (95% CI); p-value	Adj. OR [b] (95% CI); p-value
10.4 Social reward	4.9 (10.3), 0-37	1.09 (1.01-1.17); p=0.022	1.12 (0.97-1.30); p=0.125
10.7 Self-incentive	0	-	-
10.9 Self-reward	0.5 (1.2), 0-5	2.32 (1.14-4.75); p=0.021	2.90 (0.88-9.56); p=0.081
11.1 Pharmacological support	13.5 (10.0), 0-45	0.99 (0.94-1.04); p=0.598	0.91 (0.84-0.99); p=0.026
11.2 Reduce negative emotions	1.5 (3.3), 0-16	1.17 (0.97-1.40); p=0.099	1.01 (0.77-1.32); p=0.939
11.3 Conserving mental resources	0.4 (0.9), 0-4	2.08 (0.96-4.54); p=0.065	1.44 (0.51-4.05); p=0.493
12.1 Restructuring the physical environment	0.3 (0.6), 0-3	1.13 (0.49-2.61); p=0.775	0.54 (0.18-1.64); p=0.278
12.2 Restructuring the social environment	0.1 (0.4), 0-2	3.31 (0.75-14.61); p=0.114	1.46 (0.24-8.86); p=0.679
12.3 Avoidance/reducing exposure to cues for the behaviour	1.1 (1.9), 0-7	1.18 (0.91-1.54); p=0.212	0.72 (0.40-1.29); p=0.267
12.4 Distraction	0.8 (1.6), 0-6	1.12 (0.83-1.53); p=0.457	0.72 (0.42-1.22); p=0.221
12.6 Body changes	0.1 (0.7), 0-5	1.13 (0.57-2.23); p=0.732	0.87 (0.42-1.81); p=0.699
13.1 Identification of self as role model	0.3 (0.6), 0-3	1.21 (0.54-2.72); p=0.647	0.68 (0.24-1.93); p=0.465
13.2 Framing/reframing	1.1 (0.5), 0-3	0.32 (0.09-1.15); p=0.082	0.16 (0.04-0.75); p=0.020
13.5 Identity associated with changed behaviour	4.1 (6.9), 0-32	1.08 (0.99-1.17); p=0.087	0.99 (0.85-1.15); p=0.884
15.1 Verbal persuasion about capability	0.4 (1.1), 0-7	1.36 (0.77-2.42); p=0.294	0.87 (0.46-1.64); p=0.664
15.3 Focus on past success	0.6 (1.4), 0-7	1.42 (0.92-2.20); p=0.112	0.96 (0.50-1.84); p=0.894
16.1 Imaginary punishment	0.3 (0.8), 0-3	1.00 (0.52-1.92); p>0.999	0.51 (0.20-1.30); p=0.158
16.2 Imaginary reward	0.3 (0.7), 0-3	0.92 (0.44-1.95); p=0.834	0.37 (0.11-1.24); p=0.106

[a] BCTs were identified using the Behaviour Change Taxonomy v1 (Michie et al., 2011a, Michie et al., 2013a); [b] Adjusted for the total number of logins.

9.5. Discussion

This study found that pregnant smokers from high socioeconomic groups engaged more with the MumsQuit smoking cessation website, both in terms of the number of times they logged in and the number of pages they viewed, than participants from low socioeconomic groups. Using the BCTTv1 comprehensive taxonomy (Michie et al., 2013a, Michie et al., 2011a) to characterize the intervention content, it was shown that the majority – approximately 80% – of pages contained one or more of 39 distinct BCTs from all but one BCT clusters, but participants were only exposed to approximately a third of intended BCTs. A preliminary assessment of the associations between BCT exposures and abstinence showed that six BCTs representing three BCT clusters, including goals and planning, feedback and monitoring, and reward and threat, were associated with short-term abstinence without adjusting for potential confounders. As predicted, BCT exposures and engagement with the website were highly correlated, which led to some paradoxical results in the multivariate analyses indicating that this method of assessing the specific effects of BCTs was not tenable.

Although the internet is now available to a wider population than it has ever been before (International Telecommunication Union, 2014), it has been raised by HCPs in Study 5 (Chapter 8) that pregnant smokers from low socioeconomic groups would not benefit from digital smoking cessation interventions due to poor access to the internet. Findings from this study appear to support this concern, as pregnant smokers of low socioeconomic status did not engage as much with the MumsQuit intervention as did participants of high socioeconomic status. While the reasons for this were not explored in this study, it might be because pregnant smokers from low socioeconomic groups did not have regular access to the

internet, but it could also indicate that the intervention did not meet the needs and preferences of pregnant smokers across the social spectrum. More research is needed to investigate this further.

The MumsQuit intervention delivered a range of distinct BCTs from the BCTTv1 (Michie et al., 2013a, Michie et al., 2011a). The most frequently identified BCT was 'pharmacological support', which reflects that the content of MumsQuit was almost completely adapted from StopAdvisor, in which a great emphasis was placed on promoting the most effective treatment combination of behaviour support with pharmacotherapy (Brown et al., 2014). Consistent with previous studies that have shown high rates of discontinuation of using digital health behaviour change interventions (Kelders et al., 2012, Ghorai et al., 2014, Eysenbach, 2005), pregnant smokers in this study were only exposed to a fraction of BCTs identified due to their modest engagement with the website.

Findings from this study suggest a number of BCTs for inclusion in digital smoking cessation interventions for pregnant smokers in order to test their effects on cessation in a controlled experiment, such as a factorial experiment, as part of intervention optimization (Collins et al., 2014, Chakraborty et al., 2009). Of these BCTs, 'problem solving', 'social reward' and 'self-reward' have been previously found to be evidence-based in the general population (West et al., 2010) and for pregnant smokers (Lorencatto et al., 2012), and they were identified as potentially important both by pregnant smokers in Study 4 (Chapter 7) and by HCPs in Study 5 (Chapter 8) in this thesis. Other BCTs, such as 'strengthening ex-smoker identity', which have been previously identified as evidence-based for smoking cessation (West et al., 2010) but were not found to be significantly associated with abstinence in this study can be still

relevant for inclusion in digital smoking cessation interventions and their effectiveness also need to be evaluated.

This study was the first to characterize the content of a pregnancy-specific smoking cessation website by BCTs to begin the process of establishing evidence base for future digital intervention development. There is some evidence to show the incremental benefits of tailoring smoking cessation interventions to the individuals' characteristics especially in printed self-help materials (Hartmann-Boyce et al., 2014), websites (Shahab and McEwen, 2009, Civljak et al., 2013), and behavioural support for pregnant smokers (Chamberlain et al., 2013), but the ways in which a personalized set of BCTs could improve quit rates need to be explored. Moreover, it has been previously reported that specific combinations of BCTs, such as providing information about the ways in which behaviour influences health and prompting intention formation to change the behaviour, can increase the effect of behaviour change interventions for healthy eating and physical activity over that would be expected from individual BCTs (Dusseldorp et al., 2014). Future research is needed to explore this in the context of digital smoking cessation interventions.

9.5.1. Limitations

This study has several limitations. First, it had a non-experimental research design, which did not allow for assessing the relative importance of one BCT over another independent from potential confounders, such as duration of abstinence or overall engagement with the website; however, it is sufficient for informing selection of BCT components to test experimentally in digital interventions for pregnant smokers. Secondly, assessment of smoking abstinence was

based on self-report, which might be less reliable among pregnant smokers (Benowitz et al., 2002, Dietz et al., 2011). Although the absence of face-to-face contact in digital interventions would be expected to mitigate this bias, future research should include biochemical verification to assess reliability of automated data collection in this population. Thirdly, it is possible that coders failed to identify a number of BCTs in MumsQuit; however, inter-rater reliability was good and comparable with other digital smoking cessation interventions using similar approach (Michie et al., 2012b). Finally, the generalizability of the findings in this study is limited, because it involved a relatively small number of participants and only one particular digital intervention; however, more data need to be accumulated in this field, so that more robust analytic methods can be used, such as meta-regressions.

CHAPTER 10 – DESCRIPTION OF THE 'SMOKEFREE BABY' SMARTPHONE APP TO HELP PREGNANT WOMEN STOP SMOKING

10.1. Abstract

Pregnant smokers may benefit from digital smoking cessation interventions, but very few have been designed and evaluated in this population. This chapter reports the development and content of a smoking cessation smartphone app for pregnant smokers ('SmokeFree Baby'). The following frameworks for developing and optimizing complex interventions were followed: the MRC, MOST and BCW. The overarching theoretical base was provided by the COM-B model and PRIME theory, and considerable emphasis was placed on theories explaining the role of identity in controlling behaviour. Evidence from scientific literature, preceding work reported in this thesis and BCTs from the BCTTv1 informed the content and design of the app. Quitting or cutting down to three or fewer cigarettes per day were selected as target behaviours. A modular intervention was developed with five experimental modules each with a distinct intervention target: 1) harnessing a positive non-smoker identity; 2) promoting stress management during smoking cessation; 3) providing information about the health consequences of behaviour change, or lack thereof; 4) promoting the uptake of face-to-face support; and 5) facilitating behavioural substitution. Each module had two versions delivering 'intensive' or 'minimal' support. This thesis concludes with the description of the SmokeFree Baby smartphone app to help pregnant smokers stop smoking completely or substantially reduce smoking. The app is developed based on a systematic application of theory, scientific evidence and multiphase intervention optimization.

10.2. Introduction

It has been established in previous chapters that smoking during pregnancy is the main preventable cause of pre-/postnatal mortality and morbidity of infants in industrialised countries (Royal College of Physicians, 2010). Of all women who smoke prior to conception, 11-28% quit spontaneously when they learn about their pregnancy (Solomon and Quinn, 2004), and 50% stop smoking at some point during pregnancy (Anderka et al., 2010, Alves et al., 2013). However, only three quarters quit in the first trimester (Anderka et al., 2010) when most of the damage caused by maternal smoking can be avoided (Yan and Groothuis, 2014, Bickerstaff et al., 2012), and it is estimated that at least 84,000 babies are born to mothers who smoke throughout pregnancy in England and Wales each year (McAndrew et al., 2012). Although there is good evidence to show that face-to-face behavioural support helps pregnant women quit smoking (Chamberlain et al., 2013), only approximately 10-20% of pregnant smokers use this to support their quit attempts (Tappin et al., 2010, Health and Social Care Information Centre, 2014). Therefore, finding better ways to engage pregnant women with effective smoking cessation support is important, and digital interventions might represent a viable option.

As discussed in Chapters 1.4.3. and 1.5.4., evidence regarding the effectiveness of digital interventions to aid smoking cessation has been primarily based on studies of the general adult population that mainly utilized websites (Civljak et al., 2013) or text-messaging programmes (Whittaker et al., 2012) to deliver the intervention. In terms of digital interventions specifically designed for pregnant smokers, only a few exist but both text-messaging programmes (Pollak et al., 2013, Naughton et al., 2012, Abroms et al., 2015,

Naughton et al., 2013b, Soklaridis et al., 2014) and websites (Herbec et al., 2014b, Herbec et al., 2014a) have been found to be acceptable, engaging and potentially helpful for pregnant smokers. However, no study has been reported that these interventions can significantly improve quit outcomes during pregnancy compared with minimal intervention controls (Pollak et al., 2013, Naughton et al., 2012, Herbec et al., 2014b). Similarly, even though hundreds of smoking cessation apps can be found in app stores, very little research exists on their effectiveness (Bricker et al., 2014, Ubhi et al., 2015), and no study has been published on the development or evaluation of smoking cessation apps for pregnant smokers.

A multiphase approach to intervention development involves that a multicomponent intervention is assembled systematically through a number of iterative phases of intervention component selection, pilot evaluations and a RCT with an ultimate aim of achieving optimal effectiveness of the intervention (Collins et al., 2011). Whilst developing and optimizing smoking cessation interventions through iterative and multiphase processes are likely to take longer to complete than the traditional approach of testing complex interventions immediately in RCTs, it is argued that the former can advance intervention science faster because it permits intervention developers to systematically screen out ineffective intervention components and to keep only those components with the greatest potential to form better interventions (Collins et al., 2014). The development of a smoking cessation app in this thesis followed the MRC guidance (Craig et al., 2008), the MOST framework (Collins et al., 2011) and the BCW (Michie et al., 2011d, Michie et al., 2014a) for optimizing and evaluating complex interventions, as detailed in Chapters 2.1.1., 2.1.2. and 2.1.3., respectively.

Using a theoretical framework to explain the mechanisms underlying the influence of complex interventions on behaviour change is recommended according to the aforementioned multiphase approaches to intervention development (Craig et al., 2008, Collins et al., 2011, Michie et al., 2011d, Michie et al., 2014a), and it has been found that digital behaviour change interventions embedded in theory are more effective compared with interventions with less extensive or no use of theory (Webb et al., 2010a). In this thesis, identifying an initial set of intervention components to be tested was in part informed by the premises of underlying theories: primarily the COM-B model and PRIME theory (detailed in Chapters 1.3., 2.1.3., 2.2.1. and 2.2.2.). Taken together, these theories provide an overarching framework for understanding the mechanisms through which individual intervention components are expected to influence behaviour change among pregnant smokers.

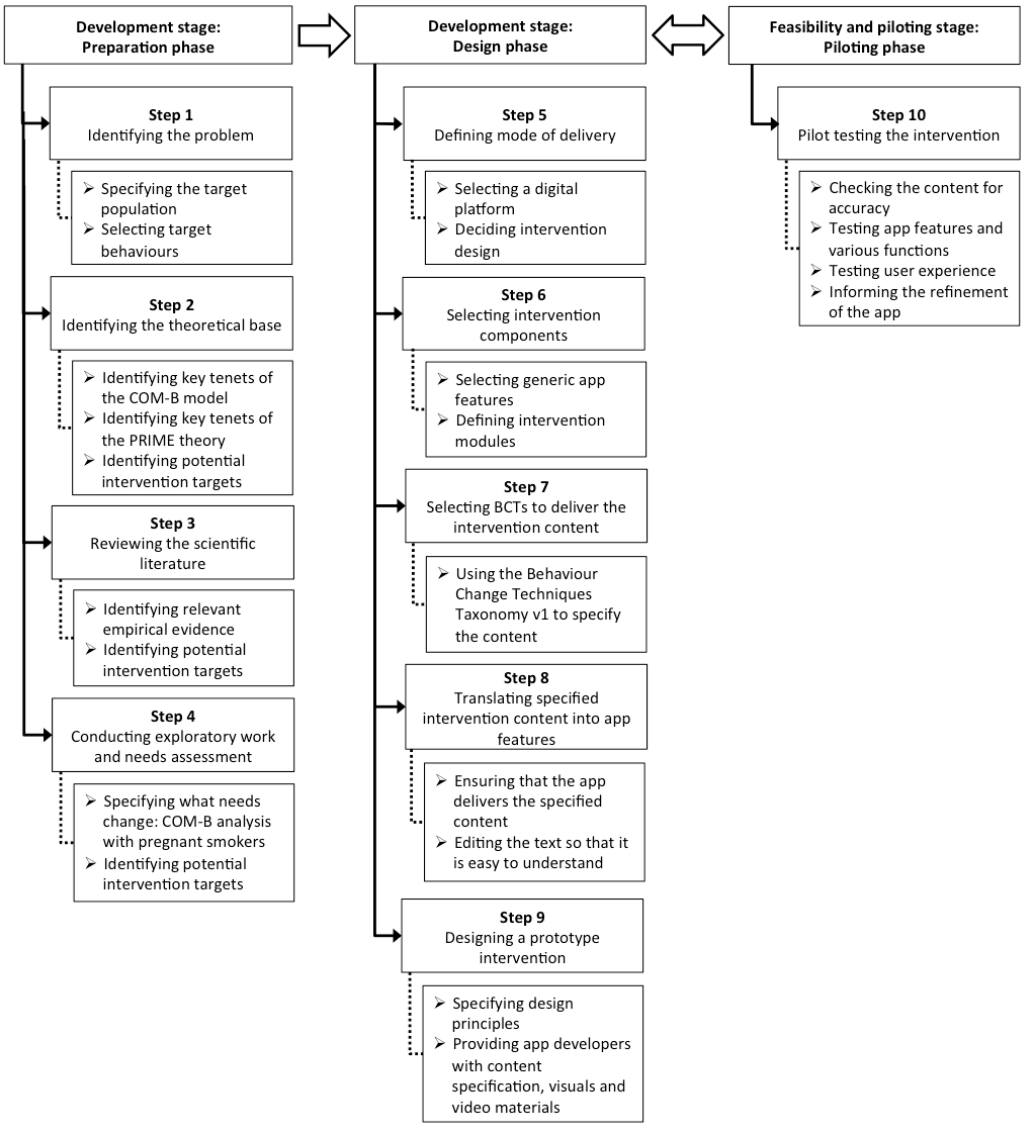
In addition to the key tenets of underlying theories, intervention components were selected based on the best available evidence from tobacco and behaviour change research. This included BCTs that have been identified in effective smoking cessation support for the general population (West et al., 2010) or specifically for pregnant women (Lorencatto et al., 2012). Moreover, BCTs used in a previously developed smoking cessation website for pregnant smokers, as reported in Study 6 in this thesis (Chapter 9), were also considered. A comprehensive description of various stages of the intervention development, and the ways by which the theoretical basis and BCTs were translated into specific intervention components is reported in the following sections.

10.3. Methods

10.3.1. Procedure

Figure 9 shows the stages of a multiphase intervention development of the SmokeFree Baby app. Details of each step are reported following the figure.

Figure 9: Multiphase intervention development of the SmokeFree Baby app



Step 1. Identifying the problem

Complete smoking cessation during pregnancy was selected as the primary target behaviour of the intervention, because it can yield the greatest health benefits both for pregnant women and their children (Benjamin-Gardner and Stotts, 2013, Dresler et al., 2006). However, for those who cannot or do not want to stop in one step, the secondary target behaviour of reducing smoking to three or fewer cigarettes per day was also specified. A smoking reduction goal was included for a number of reasons, as follows. First, studies have suggested that a substantial smoking reduction (i.e. down to 2-3 cigarettes per day) can be associated with improved birth outcomes (Windsor et al., 1999, England et al., 2001, Yan and Groothuis, 2015) and that there is a dose-response relationship between the baby's overall prenatal tobacco exposure and birth weight (Hebel et al., 1988). Secondly, it was recognized that pregnant smokers have very low self-confidence in their ability to stop smoking (Maxson et al., 2012, Woodby et al., 1999); therefore, the smoking reduction option may give them the opportunity to experiment with smoking cessation and potentially to gain some confidence and build up self-efficacy before they try to stop smoking completely. Thirdly, pregnant women may make a number of quit attempts during pregnancy (Pickett et al., 2003), and evidence from the general population suggests that the process of smoking cessation can involve multiple transitions of trying to stop smoking and trying to cut down (Hughes et al., 2013); therefore, it is important to engage pregnant smokers with the cessation support even if they lapse or relapse. Lastly, RCTs have found that smokers in the general population who cut down prior to complete cessation are as likely to be abstinent at six months as those who quit abruptly (Lindson-Hawley et al., 2012), and findings from a prospective population

survey have shown that those who reduce smoking have higher odds of quit attempts and cessation at six months than those who do not cut down (Beard et al., 2013).

Step 2. Identifying the theoretical base

Key tenets of the COM-B model and PRIME theory were applied to drive intervention component selection. For example, PRIME theory argues that maintaining a desired behaviour change requires mental energy and for the individual to exercise self-control in situations when competing wants and needs to smoke arise. One way to conserve mental energy and to cope with momentary desires to smoke is by engaging with an alternative behaviour; therefore, it was identified that the intervention needs to provide distraction from urges to smoke and improve pregnant smokers' skills to substitute smoking with alternative behaviours. Additionally, as detailed in Chapter 2.2.2., people's identities with underlying identity motives are important sources of motivation to influence smoking or cessation. In line with this, fostering a positive non-smoker identity and increasing the salience of related identity motives were selected as core components of the proposed intervention.

Step 3. Reviewing the scientific literature

In order to identify further intervention targets, systematic literature searches were conducted on PubMed in relation to smoking and cessation in pregnancy, interventions for pregnant smokers, digital smoking cessation interventions and BCTs used in smoking cessation interventions. This identified for example that improving pregnant smokers' skills to cope with stress (Hauge et al., 2012, Gyllstrom et al., 2012, Mantzari et al., 2012), improving

knowledge about the health consequences of smoking (Bull et al., 2007, Gould et al., 2013, Polen et al., 2015), facilitating the uptake of face-to-face support (Tappin et al., 2010, Health and Social Care Information Centre, 2014), providing distraction from urges to smoke and giving tips to avoid social cues for smoking (Naughton et al., 2013c) might be important to include. Although providing financial incentives could also be relevant and potentially effective among pregnant smokers (Tappin et al., 2015, Higgins et al., 2012, Bauld and Coleman, 2009, Chamberlain et al., 2013, Mantzari et al., 2012), it was not feasible to include in this intervention, as the aim was to develop a fully automated form of support.

Step 4. Conducting exploratory work and needs assessment

Findings from this thesis and that of previous studies in the literature informed a list of BCTs to be considered for inclusion in the app. Table 23 reports the list and the source of evidence for each BCT considered. This included BCTs that were identified in treatment manuals of behavioural support for smoking cessation provided by the English stop smoking services and were found to be associated with short-term quit success (West et al., 2010), and BCTs that were identified in intervention descriptions of effective behavioural interventions for pregnant smokers (Lorencatto et al., 2012). As part of the exploratory work in this thesis, qualitative studies were conducted with pregnant smokers and HCPs (Studies 4 and 5) to identify what would need to change in pregnant smokers and/or in their environment in order for them to stop smoking, and how digital interventions should be configured in order to improve pregnant smokers' cessation efforts. A number of potential intervention targets were identified in these studies (as reported previously in Tables 17 and 19, respectively), which were then linked with BCTs that could be suitable to deliver the specific intervention content.

Moreover, BCTs used in a pregnancy-specific smoking cessation website were also identified in Study 6 (Chapter 9). In order to improve the comparability of findings from different sources, BCTs from the smoking taxonomy (Michie et al., 2011c) were mapped onto relevant BCTs from the BCTTv1 (Michie et al., 2011a, Michie et al., 2013a) and vica versa, if applicable.

Step 5. Defining mode of delivery

An app as mode of delivery of the smoking cessation intervention was selected for the following reasons: 1) the intervention can be delivered on a relatively low cost per user and low marginal cost (Guerriero et al., 2013); 2) it could reach pregnant smokers who might otherwise be missed, since they do not engage with face-to-face support (BinDhim et al., 2014); 3) apps can permit increased fidelity in intervention delivery; 4) apps represent more advanced technology than text-messaging and websites, as they can take full advantages of a multi-touch interface and other functionalities; and 5) apps can be available both offline and online. The proposed app was called SmokeFree Baby, operational on Android 4.1 or later and iOS 6.0 or later for both smartphones and tablets. For the delivery of intervention content, a modular intervention design was selected. In line with the MRC framework that recommends thinking about implementation up front that can be fed back to development, the following strategies were specified to increase engagement with the app: 1) intervention content to be delivered preceding a selected quit date; 2) teasers to be included for further features that can be unlocked at a later stage; 3) unique content to be released on a daily basis throughout pregnancy; and 4) daily logins to be rewarded with new content.

Table 23: Behaviour change techniques (BCTs) identified in the scientific literature and studies reported in this thesis to inform the specification of BCTs in the SmokeFree Baby app

BCT taxonomy [a]	BCT codes [a]	BCTs [a]	Associated with self-reported four-week quit success [b]	Associated with CO-verified four-week quit success [b]	Evidence-based in pregnancy [c]	Identified by pregnant smokers (Study 4)	Identified by health care providers (Study 5)	Identified as potentially useful in MumsQuit (Study 6)	Included in SmokeFree Baby
Smoking	BS2	Facilitate relapse prevention and coping							
BCTTv1	1.2	Problem solving							
Smoking	BM11	Measure expired-air carbon monoxide							
Smoking	BM4	Provide rewards contingent on successfully stopping smoking							
BCTTv1	10.4	Social reward							
BCTTv1	10.7	Self-incentive							
BCTTv1	10.9	Self-reward							
Smoking	A1	Advise on stop smoking medication							
Smoking	A4	Ask about experiences of stop smoking medications that the smoker is using							
BCTTv1	11.1	Pharmacological support							
Smoking	A5	Give options for additional and later support							
BCTTv1	3.1	Social support (unspecified)							

BCT taxonomy [a] *(Table 23 continued)*	**BCT codes** [a]	**BCTs** [a]	**Associated with self-reported four-week quit success** [b]	**Associated with CO-verified four-week quit success** [b]	**Evidence-based in pregnancy** [c]	**Identified by pregnant smokers (Study 4)**	**Identified by health care providers (Study 5)**	**Identified as potentially useful in MumsQuit (Study 6)**	**Included in SmokeFree Baby**
Smoking	RC8	Elicit client views							
Smoking	BS7	Advise on changing routines							
BCTTv1	12.3	Avoidance/reducing exposure to cues for the behaviour							
Smoking	BM8	Strengthen ex-smoker identity							
BCTTv1	13.5	Identity associated with changed behaviour							
Smoking	RC3	Explain the purpose of CO monitoring							
Smoking	RC6	Provide information on withdrawal symptoms							
Smoking	A2	Advise on/facilitate use of social support							
Smoking	BS10	Advise on conserving mental resources							
BCTTv1	11.3	Conserving mental resources							
Smoking	RC9	Summarize information/confirm client decisions							
Smoking	RC10	Provide reassurance							
Smoking	BM2	Boost motivation and self-efficacy							

BCT taxonomy [a] *(Table 23 continued)*	**BCT codes** [a]	**BCTs** [a]	**Associated with self-reported four-week quit success** [b]	**Associated with CO-verified four-week quit success** [b]	**Evidence-based in pregnancy** [c]	**Identified by pregnant smokers (Study 4)**	**Identified by health care providers (Study 5)**	**Identified as potentially useful in MumsQuit (Study 6)**	**Included in SmokeFree Baby**
BCTTv1	15.1	Verbal persuasion about capability							
BCTTv1	15.2	Mental rehearsal of successful performance							
BCTTv1	15.3	Focus on past success							
BCTTv1	15.4	Self-talk							
Smoking	RC7	Use reflective listening							
Smoking	BM1	Provide information on the consequences of smoking and smoking cessation							
BCTTv1	5.1	Information about health consequences							
BCTTv1	5.3	Information about social and environmental consequences							
BCTTv1	5.6	Information about emotional consequences							
Smoking	BS1	Facilitate barrier identification and problem solving							
Smoking	BS3	Facilitate action planning/identify relapse triggers							
BCTTv1	1.4	Action planning							
Smoking	BS4	Facilitate goal setting							

BCT taxonomy [a] *(Table 23 continued)*	**BCT codes** [a]	**BCTs** [a]	**Associated with self-reported four-week quit success** [b]	**Associated with CO-verified four-week quit success** [b]	**Evidence-based in pregnancy** [c]	**Identified by pregnant smokers (Study 4)**	**Identified by health care providers (Study 5)**	**Identified as potentially useful in MumsQuit (Study 6)**	**Included in SmokeFree Baby**
BCTTv1	1.1	Goal setting (behaviour)							
BCTTv1	1.3	Goal setting (outcome)							
Smoking	RI1	Assess current and past smoking behaviour							
BCTTv1	2.3	Self-monitoring of behaviour							
Smoking	RI2	Assess current readiness and ability to quit							
Smoking	RC5	Offer/direct toward appropriate written materials							
BCTTv1	12.1	Restructuring the physical environment							
BCTTv1	12.2	Restructuring the social environment							
BCTTv1	12.4	Distraction							
BCTTv1	11.2	Reduce negative emotions							
BCTTv1	8.2	Behavioural substitution							
Smoking	RC2	Elicit and answer questions							
Smoking	RC4	Explain expectations regarding treatment program							
BCTTv1	9.2	Pros and cons							
BCTTv1	2.2	Feedback on behaviour							
BCTTv1	2.4	Self-monitoring of outcome(s) of behaviour							

BCT taxonomy [a] *(Table 23 continued)*	**BCT codes** [a]	**BCTs** [a]	**Associated with self-reported four-week quit success** [b]	**Associated with CO-verified four-week quit success** [b]	**Evidence-based in pregnancy** [c]	**Identified by pregnant smokers (Study 4)**	**Identified by health care providers (Study 5)**	**Identified as potentially useful in MumsQuit (Study 6)**	**Included in SmokeFree Baby**
BCTTv1	2.7	Feedback on outcome(s) of behaviour							
BCTTv1	6.2	Social comparison							
Smoking	RD1	Tailor interaction appropriately							
BCTTv1	1.5	Review behavioural goal(s)							
BCTTv1	1.6	Discrepancy between current behaviour and goal							
BCTTv1	1.9	Commitment							
BCTTv1	3.2	Social support (practical)							
BCTTv1	3.3	Social support (emotional)							
BCTTv1	4.2	Information about antecedents							
BCTTv1	6.3	Information about others' approval							
BCTTv1	8.3	Habit formation							
BCTTv1	9.1	Credible source							
BCTTv1	9.3	Comparative imagining of future outcomes							
BCTTv1	12.6	Body changes							
BCTTv1	13.1	Identification of self as role model							
BCTTv1	13.2	Framing/reframing							
BCTTv1	13.3	Incompatible beliefs							

BCT taxonomy [a] *(Table 23 continued)*	**BCT codes** [a]	**BCTs** [a]	**Associated with self-reported four-week quit success** [b]	**Associated with CO-verified four-week quit success** [b]	**Evidence-based in pregnancy** [c]	**Identified by pregnant smokers (Study 4)**	**Identified by health care providers (Study 5)**	**Identified as potentially useful in MumsQuit (Study 6)**	**Included in SmokeFree Baby**
BCTTv1	13.4	Valued self-identity							
BCTTv1	16.2	Imaginary reward							
BCTTv1	16.3	Vicarious consequences							

[a] BCTs were from the smoking taxonomy (Michie et al., 2011c) or the Behaviour Change Taxonomy v1 (BCTTv1) (Michie et al., 2011a, Michie et al., 2013a) and BCT codes and labels were used accordingly; [b] BCTs were identified in treatment manuals of behavioural support for smoking cessation provided by the English stop smoking services (West et al., 2010); [c] BCTs were identified in intervention descriptions of effective behavioural interventions for pregnant smokers (Lorencatto et al., 2012).

Initial BCT taxonomy used to specify the intervention content

Overlap with initial BCT taxonomy used

Identified intervention targets were linked with BCTs

Step 6. Selecting intervention components

Informed by key tenets of underlying theories, literature review, evidence from exploratory studies and expert consensus in the research team after Steps 2-4 in the preparation phase, a set of core intervention components was selected. These were grouped into general app features to provide at least some engagement for all users, and five experimental modules to which users would be randomly allocated. For each experimental module, content of a minimal and intensive version was also specified. Selected intervention targets were linked with intervention functions from the BCW that represent broad categories of functions by which the intervention could bring about behaviour change (Michie et al., 2014a).

Step 7. Selecting BCTs to deliver the intervention content

In order to design the intervention in a systematic, replicable, comparable and testable manner, the BCTTv1 (Michie et al., 2011a, Michie et al., 2013a) was applied to specify the intervention content. The BCTTv1 was chosen because it encompasses a comprehensive list of 93 BCTs and selected BCTs that were included in the SmokeFree Baby app is reported in Table 23. All general app features as well as experimental intervention modules have been specified by BCTs, so for example, the intervention content in the identity module was delivered by using a combination of nine BCTs. This included BCTs that were identified in the exploratory work (Step 4) as potentially important ('identity associated with changed behaviour', 'social comparison', 'social support' and 'self-talk'), and if needed, additional BCTs from the BCTTv1 were also selected ('identification of self as role model',

'framing/reframing', 'incompatible beliefs', 'valued self-identity' and 'comparative imagining of future outcomes').

Step 8. Translating specified intervention content into app features

This step involved repeated discussions between members of the research team and app developers. Several iterations of SmokeFree Baby were produced until agreement was reached that the general app features and experimental modules delivered the specified intervention content as intended, and the features were feasible to implement in terms of programming. The text for the app was edited to ensure that it was as brief as possible, easy to understand and did not contain scientific jargon.

Step 9. Designing a prototype intervention

Design principles were specified as follows. A harmonious design with clean lines was created throughout the app. As suggested in a recent Delphi study exploring optimal features of health-related websites (Schneider et al., 2012), easy log-in procedures were adopted in the app, and the length of the background questionnaire was kept to the minimum and it was presented with a progress bar in order to minimize respondent burden and avoid early dropout. Greater emphasis was placed on the generic features and the intensive modules by having visuals and interactive elements included, such as quizzes, a game and a relaxation exercise. The minimal versions contained text only. The app structure was consistent and each page was titled to ensure easy navigation between features. Personalised touches included greeting the users with the name provided at registration. In-app notifications were

used to signpost if new content is released in various features. App developers were provided with a detailed description of the intervention content, including the general operation of the app and functions of the specific features, and the video materials to be used in the app.

Step 10. Pilot testing the intervention

In the final step, all functions and features were tested in an iterative manner in order to fix programme bugs, and checked whether the intervention description was implemented accurately. Moreover, an initial user testing was conducted within the research team and non-pregnant users, and modifications were made to correct errors (e.g. incorrect feedback on progress), improve design (e.g. increase font size of the text) and improve user experience (e.g. improve navigation within the built-in game) and ensure the stability of the app on various platforms, including tablets.

10.3.2. Contributions

I conceived and designed the SmokeFree Baby app, completed the stages of the intervention development from Step 1 to 10, as detailed in Chapter 10.3.1., and wrote up the final study. Robert West, Susan Michie, Lion Shahab, Jamie Brown and David Crane contributed to the development process and design of the app, and to the write up of the study. Matthew West created the graphic design for the app, Daniel West wrote the programme, and Jamie West contributed to the copy editing of the content.

10.4. Results

The SmokeFree Baby app has been designed to help pregnant smokers stop smoking completely or reduce smoking to three or fewer cigarettes per day. It is available for free and can be used both on smartphones and tablets. The intervention involves automated support throughout pregnancy without face-to-face contact, and a number of generic app features are available for everyone. In addition, five modules with 'intensive' and 'minimal' versions are also included, in which a 'module' refers to the unit of intervention components that is tested experimentally in the app. Each module has a specific topic, and within each module a selection of BCTs is used to deliver the intervention content accordingly. Sample screenshots of SmokeFree Baby are reported in Appendix F-10, and details of the content of the app are discussed below.

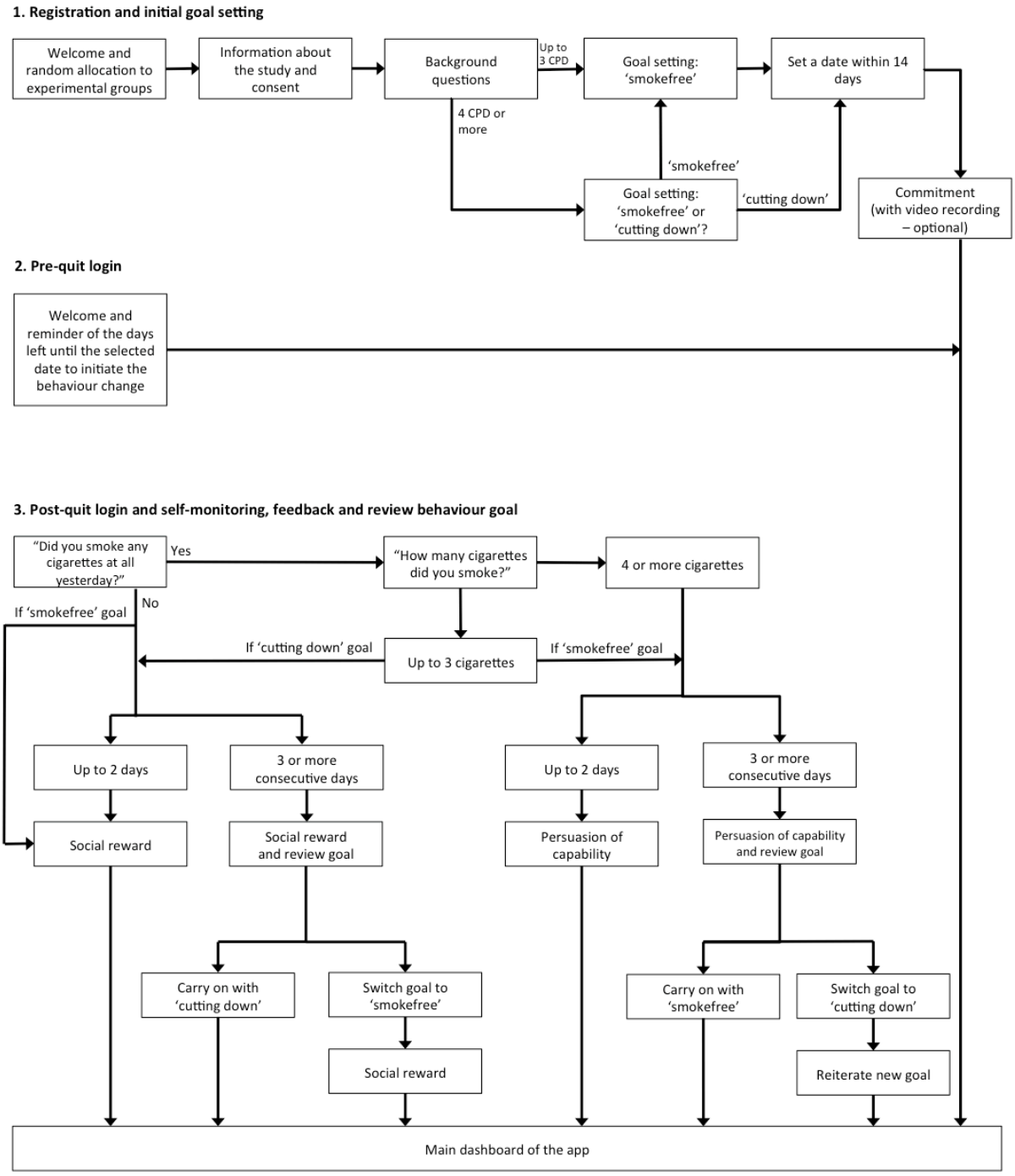
10.4.1. Registration and generic app features

The process of registration and subsequent logins in the SmokeFree Baby app is shown in Figure 10. Participants are asked to read the information page to learn more about the study and to give consent for participation. Those who give consent complete a baseline questionnaire. Depending on how many cigarettes they smoke per day at baseline, participants can set a goal for themselves as follows. Those who report four or more cigarettes per day can decide whether they want to stop smoking completely or to cut down to three or fewer cigarettes per day. Participants who smoke up to three cigarettes at baseline are only provided with the smokefree option. All participants can set a date within two weeks of completing the registration in the app to initiate their selected behaviour change (i.e.

quitting or cutting down), and they are encouraged to commit themselves to their selected goal. Participants are encouraged to open the app preceding their selected day, and they are reminded of the days left until they initiate the behaviour change. Post-quit logins start with asking participants if they smoked any cigarettes at all in the last 24 hours, and if so, how many. If the initially selected smoking reduction goal is met for three consecutive days, pregnant women are encouraged to stop smoking completely. On the other hand, if the smokefree goal is not met for three consecutive days, participants can change the target behaviour to smoking reduction. A detailed description of the content of the app relating to feedback and monitoring is reported in Appendix F-11.

Table 24 reports the generic features that are available to all participants (full content specification is reported in Appendix F-12). Prior to the individuals' selected date to initiate behaviour change, pregnant smokers are given access to the 'Tools to Quit' feature, in which they can learn more about nicotine addiction, withdrawal symptoms and members of the research team who developed the app, they are encouraged to think about why they want to quit, and they are given tips and advice to help them prepare for the behaviour change. Following quitting or cutting down, additional features become available: 1) to provide information about smoking cessation medications and the use of NRT during pregnancy ('Medicine'), 2) to give daily tips and advice to help women engage in social situations without smoking ('Tip of the Day'), 3) to provide a savings calculator for participants to monitor how much money they have saved since quitting or cutting down, 4) to prompt social support ('Support') and 5) to prompt reaffirming commitment with the self-selected behaviour change goal ('Memos').

Figure 10: Registration and subsequent logins in the SmokeFree Baby app



CPD: Cigarettes per day

Table 24: Content specification of generic app features with proposed process of change, intervention functions and BCTs applied in SmokeFree Baby

Features	Key targets in specific features	Potential process of change [a]	Intervention functions [b]	Behaviour change techniques [c]	Sample text
Goal setting and commitment	• Ask the person to set a behaviour change goal for herself (i.e. quitting or cutting down) • Ask the person to commit herself to a selected behaviour change goal • Prompt the person to review her initial goal and consider modifying it in light of progress	• Motivation: reflective (wants and needs) • Motivation: automatic (self-confidence)	Education	1.1 Goal setting (behaviour) 1.5 Review behaviour goal 1.6 Discrepancy between current behaviour and goal 1.9 Commitment	"As you're progressing very well here, it's a good time to revisit your initial goal and think about stopping smoking completely. You can do this!"
Feedback and monitoring	• Encourage the person to record daily in the app whether, and if so, how many cigarettes she smoked • Provide feedback on performance of the selected behaviour (e.g. number of smokefree days) • Praise the person for progress in behaviour change • Advise the person to think about previous successes in performing the behaviour • Prompt self-praise and self-reward • Boost motivation and increase self-confidence	• Motivation: automatic (positive reinforcement) • Motivation: automatic (self-confidence)	Persuasion	2.2 Feedback on behaviour 2.3 Self-monitoring of behaviour 10.4 Social reward 10.7 Self-incentive 10.9 Self-reward 15.1 Verbal persuasion about capability 15.3 Focus on past success	"You've reached your one-week milestone. Sounds like a great achievement! Why don't you think about a reward for yourself if you stick to your smokefree goal for the next 7 days?"
Savings calculator	• Savings calculator appears as a reward for engaging with the behaviour change • Reward for success • Monitor outcome of behaviour • Provide feedback on how much money the person has saved	• Motivation: automatic (positive reinforcement)	Persuasion Incentivisation	2.4 Self-monitoring of outcome of behaviour 2.7 Feedback on outcome of behaviour	"Saved so far up to £10. That's enough to buy a baby bottle."

Features *(continued)*	Key targets in specific features	Potential process of change [a]	Intervention functions [b]	Behaviour change techniques [c]	Sample text
'Tools to Quit'	• Provide information about nicotine addiction • Provide information about withdrawal symptoms • Prompt the person to prepare for the behaviour change • Prompt reasons to quit • Provide information about the experts who developed the app	• Capability: psychological (knowledge) • Motivation: reflective (wants and needs) • Plans	Education Persuasion	1.4 Action planning 3.1 Social support (unspecified) 9.1 Credible source 11.1 Pharmacological support 12.3 Avoidance/reducing exposure to cues for the behaviour	"SmokeFree Baby has been developed by a research team at University College London who specialize in smoking cessation."
'Social'	• Strengthen self-regulation to cope with social cues of smoking • Prompt social support and encouragement • Advise to avoid environmental and social cues of smoking • Advise the person to think about the influence of behaviour change on the immediate social environment	• Capability: psychological (self-regulation) • Capability: psychological (skills) • Plans • Opportunity: social influence (support)	Education Persuasion	1.4 Action planning 3.1 Social support (unspecified) 3.2 Social support (practical) 3.3 Social support (emotional) 4.2 Information about antecedents 5.3 Information about the social and environmental consequences 6.2 Social comparison 6.3 Information about others' approval 12.1 Restructuring the physical environment 12.2 Restructuring the social environment 12.3 Avoidance/reducing exposure to cues for the behaviour 15.2 Mental rehearsal of successful performance 16.2. Imaginary reward 16.3. Vicarious consequences	"Imagine that you are out with friends and you're the only one who doesn't smoke. Prepare in advance what you're going to do when they go to have a cigarette. For example you can browse the internet on your phone to kill time."

Features *(continued)*	Key targets in specific features	Potential process of change [a]	Intervention functions [b]	Behaviour change techniques [c]	Sample text
'Medicine'	• Provide information about NRT use during pregnancy and how to obtain it	• Capability: psychological (knowledge)	Education	11.1 Pharmacological support	"If you feel that stopping smoking would be very difficult for you, or you want to cut down first, try nicotine replacement products - they will help you manage your cravings and withdrawal."
'Support'	• Promote ready access to social support	• Opportunity: social influence (social support)	Persuasion	1.4 Action planning 3.1 Social support (unspecified) 15.1 Verbal persuasion about capability	"Think about the people closest to you who you can rely on when you need support. Add their phone numbers here and call them if you feel that the urge to smoke is getting overwhelming or whenever you find it difficult to stick to your smokefree goal."
'Memos'	• Promote ready access to social support • Advise the person to ask friends and family for their support and encouragement • Prompt commitment with the behaviour change	• Opportunity: social influence (social support) • Motivation: reflective (commitment)	Persuasion	3.1 Social support (unspecified) 1.9 Commitment 15.1 Verbal persuasion about capability	"Help maintain your motivation to stop smoking or cut down by recording supportive video messages from your friends and family. You can also record your personal commitment to the goal you set for yourself."

[a] Proposed process of change was identified according to key tenets of the COM-B model and PRIME theory; [b] Intervention functions were identified based on the Behaviour Change Wheel; [c] Behaviour change techniques were selected from the BCTTv1.

10.4.2. Experimental intervention modules

Figure 11 shows the modular intervention structure of SmokeFree Baby, and Table 25 reports the content specification of each experimental intervention module, including their minimal and intensive versions. Key targets of the specific modules are linked with underlying mechanisms of change, according to the COM-B model and PRIME theory, intervention functions and the BCTs applied. Full content specifications of the five experimental modules are reported in the Appendix (from Appendix F-13 to F-17, respectively).

1. 'Identity' module

The minimal version of this module includes brief advice about the importance of establishing a non-smoker identity when making a quit attempt. In addition to this, the intensive version provides daily tips and motivational messages about identity and identity change in smoking cessation. It aims to increase the salience of a positive identity in relation to the behaviour change and includes an interactive feature ('I am…') for women to build their new identity as a non-smoker. To facilitate the identification with positive role models for cessation, video clips are included with an ex-smoker pregnant woman who talks about her experiences, struggles and successes during the smoking cessation process ('Ex-smokers'). To increase the salience of a 'mother' identity, this module is tailored to the individual's weeks of pregnancy to provide information about the development stage of the fetus each week ('Pregnancy stages') and it prompts women to document their pregnancy using a built-in feature in the app ('Video Diary').

2. 'Stress relief' module

The minimal version provides brief advice about the association between smoking and stress, and recommends relaxation techniques to be used to cope with negative emotional states and withdrawal. The intensive version adds to these by promoting planning to prepare for copying with stressful situations, negative emotional states and urges to smoke, and it includes 80 stress reduction tips and advice that pregnant women can use to create their own stress management plan within the app ('Stress Plan'). Additionally, the module has an interactive feature to improve women's stress management skills by training them to perform a deep breathing exercise ('Deep Breathing').

3. 'Health effects' module

The minimal version contains very brief advice about the health effects of smoking during pregnancy and benefits of stopping smoking. The intensive version provides comprehensive overview of the harmful effects of smoking, including pregnancy complications, smoking-attributable diseases both for the mothers and their children, life expectancy, mental health, and quality of life. Information about the health risks of passive smoking is also provided. To minimize potential emotional distress for pregnant women, the module is designed so that the messages are framed around the potential benefits that can be gained by quitting or cutting down. The module applies a life-course perspective in presenting the information in order to emphasize the long-term benefits of quitting, and the intervention content is delivered in a number of different ways, such as through quizzes ('Health Quiz'), daily 'health facts' and

interactive visuals that allow users to explore as much or as little as they want of the available content (‘My Body’ and ‘My Baby’).

4. ‘Face-to-face’ module

The minimal version includes brief advice about the ways in which pregnant smokers can book an appointment with an expert stop smoking advisor. In the intensive version, various features deliver the intervention content to encourage women to engage with evidence based face-to-face support, and to discuss smoking with their midwife and general practitioner. Users are given information about different forms of face-to-face support, such as one-to-one support, group support or telephone support, with details about the ways in which they can access to their preferred type of support. Video clips of a real-life specialist stop smoking in pregnancy advisor are included who talks in a friendly and informal manner about what face-to-face support involves (‘Pro Advice’). She explains what pregnant smokers can expect when they make an appointment with an expert advisor, and guides them through the process of quitting with the support provided. Additionally, the module provides easy access to quitlines and local services in the UK, USA, Canada, Australia, New Zealand and Republic of Ireland through the app (‘Local Services’).

5. ‘Behaviour’ module

The minimal version provides brief advice about internal and external sources of urges, and prompts the use of distraction strategies to cope with them. Beyond these, the intensive version prompts the substitution of smoking with a positive or neutral behaviour, and it

provides distraction quizzes (‘Distraction Q&A’) and a built-in game (‘Baby Name Game’), both of which resonate with pregnancy. In addition, 80 different tips and advice, which were gathered through discussions between members of the research team, are included, and participants are encouraged to create their own distraction plan by using the feature provided (‘Distraction Plan’).

Figure 11: Structure of the experimental intervention modules

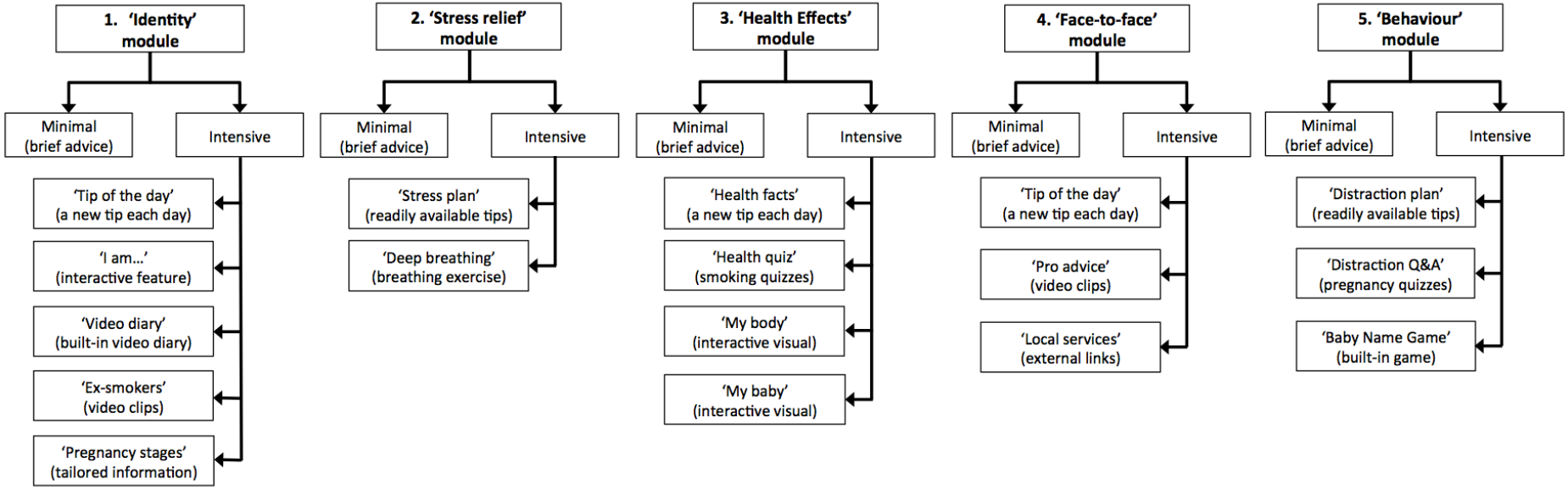


Table 25: Content specification of experimental intervention modules with proposed process of change, intervention functions and BCTs applied in SmokeFree Baby

Modules	Key targets in specific modules	Potential process of change [a]	Intervention functions [b]	Behaviour change techniques [c]	Sample text
1. 'Identity'					
Minimal	• Foster identity change	• Motivation: reflective (identity)	Persuasion	13.5 Identity associated with changed behaviour	"Building up a new identity for yourself as someone who used to smoke, but for whom smoking is not an option any more is an important part of leaving smoking behind for good."
Intensive	• Foster identity change • Increase salience of a valued identities • Increase self-esteem (prompt positive self-labels, self-images, and self-thoughts) • Prompt identification with positive role models for cessation • Facilitate bonding with the baby	• Motivation: reflective (identity) • Opportunity: social influence (modelling)	Persuasion Modelling	13.5 Identity associated with changed behaviour 13.4 Valued self-identity 13.3 Incompatible beliefs 13.2 Framing/reframing 13.1 Identification of self as a role model 3.1 Social support (unspecified) 6.2 Social comparison 9.3 Comparative imagining of future outcomes 15.4 Self talk	"You might feel that smoking has always been a part of who you are, and stopping smoking would mean that you lose something of yourself. Think about what you can gain by making not smoking an essential part of your identity. Make a list of all the things about yourself that won't change even if you become a non-smoker."
2. 'Stress relief'					
Minimal	• Provide information about the association between smoking and stress • Advise the person to use stress management techniques	• Capability: psychological (knowledge)	Education	11.2 Reduce negative emotions 12.6 Body changes	"Bear in mind that smoking doesn't reduce stress, it simply relieves your withdrawal symptoms. Relaxation techniques, breathing exercise or low intensity physical activity can actually help you relieve your stress and deal with cravings in one go."

Modules	Key targets in specific modules	Potential process of change [a]	Intervention functions [b]	Behaviour change techniques [c]	Sample text
Intensive *('Stress relief' continued)*	• Provide information about the association between smoking and stress • Advise the person to use stress management techniques • Strengthen self-regulation • Improve stress management skills • Alter beliefs about smoking and stress • Prompt planning	• Capability: psychological (knowledge) • Capability: psychological (self-regulation) • Capability: psychological (skills) • Motivation: reflective (beliefs) • Plans • Memory processes to recall coping strategies	Education Training	11.2 Reduce negative emotions 12.6 Body changes 1.2 Problem solving 1.4 Action planning 8.3 Habit formation 11.3 Conserving mental resources	"Here are 3 top tips to reduce your stress without smoking. Try them out the next time you begin to feel stressed."
3. 'Health effects'					
Minimal	• Provide information about the health consequences of smoking and benefits of cessation	• Capability: psychological (knowledge) • Motivation: reflective (wants and needs)	Education Persuasion	5.1 Information about health consequences	"Do the best you can to cut down, or give up smoking, and you and your baby will have a better chance of leading happier, healthier lives."
Intensive	• Provide information about the health consequences of smoking and benefits of cessation • Address misconceptions about the effects of smoking	• Capability: psychological (knowledge) • Motivation: reflective (wants and needs) • Motivation: reflective (beliefs)	Education Persuasion	5.1 Information about health consequences 5.3 Information about social and environmental consequences 5.6 Information about emotional consequences	"Delivering a baby with a low birth weight is the main pregnancy complication known to be linked with both active and passive smoking. The less you smoke, the greater your chances of having a normal birth are."
4. 'Face-to-face'					
Minimal	• Provide information about sources of support and how to access them	• Capability: psychological (knowledge)	Education	3.1 Social support (unspecified)	"You can book an appointment at your local stop smoking service via phone or email, or you can also get a referral from your midwife or GP."
Intensive	• Provide information about sources of support and how to access them • Provide access to more	• Capability: psychological (knowledge) • Opportunity: physical (access to support)	Education Persuasion	3.1 Social support (unspecified) 3.2 Social support (practical)	"It's never too late to change your mind about getting face-to-face support from a stop smoking advisor. Even if you decided not to get support at first, you can always

Modules	Key targets in specific modules	Potential process of change [a]	Intervention functions [b]	Behaviour change techniques [c]	Sample text
Intensive *('Face-to-face' continued)*	intensive support (contact details are available for nine countries) • Address misconceptions about face-to-face support • Encourage the person to make and appointment	• Opportunity: social influence (support) • Motivation: reflective (beliefs)			ask your GP or midwife for a referral to your local stop smoking clinic, or contact them yourself."
5. 'Behaviour'					
Minimal	• Provide information about sources of urges to smoke • Advise the person to use distraction techniques to cope with urges	• Capability: psychological (knowledge) • Capability: psychological (self-regulation)	Education	4.2 Information about antecedents 12.4 Distraction	"It's important to try and distract yourself from your urges to smoke. Have a think about what you can do instead of smoking. One option might be to play a game on your phone."
Intensive	• Provide information about sources of urges to smoke • Advise the person to use distraction techniques to cope with urges • Strengthen self-regulation • Improve skills to distract oneself from urges • Prompt planning • Provide distraction	• Capability: psychological (knowledge) • Capability: psychological (self-regulation) • Capability: psychological (skills) • Motivation: automatic (changing habits)	Education Enablement	4.2 Information about antecedents 12.4 Distraction 1.2 Problem solving 1.4 Action planning 8.2 Behaviour substitution 8.3 Habit formation	"Decorate your baby's room. Search on the internet for ideas then try to do little bits and pieces every time you think about smoking"

[a] Proposed process of change was identified according to key tenets of the COM-B model and PRIME theory; [b] Intervention functions were identified based on the BCW; [c] Behaviour change techniques were selected from the BCTTv1.

10.5. Discussion

SmokeFree Baby is the first theory- and evidence-based smoking cessation app that was specifically designed to meet the needs of pregnant smokers and developed by systematically following a multiphase intervention optimization strategy. It aims to help pregnant smokers stop smoking or, if that is not possible, cut down the cigarettes smoked per day. Key tenets of the COM-B model (Michie et al., 2011d, Michie et al., 2014b) and PRIME theory (West and Brown, 2013, West, 2006b), empirical evidence identified in the scientific literature, evidence-based BCTs, and findings from extensive exploratory work informed the content specification of the app. Five experimental intervention modules were included in the app to harness identity change, promote stress management, provide information about the health effects of smoking and cessation, facilitate the uptake of face-to-face support and promote behavioural substitution.

Intervention components in SmokeFree Baby were designed to target a broad range of influences on behaviour, including psychological capability (e.g. improve self-regulation to maintain abstinence), social influences (e.g. provide positive role models by means of ex-smoker pregnant women), physical opportunity (e.g. provide ready access to cessation support throughout pregnancy), automatic motivation (e.g. provide distraction from urges to smoke), reflective motivation (e.g. foster a non-smoker identity), and plans (e.g. promote planning to cope with stressful situations). According to these, six intervention functions from the BCW (Michie et al., 2011d, Michie et al., 2014a) were identified as potentially useful, such as education, persuasion and modelling, and 45 distinct BCTs from the BCTTv1 (Michie et al., 2011a, Michie et al., 2013a) were selected to deliver the intervention content.

In line with MOST, SmokeFree Baby is currently being evaluated in a factorial screening experiment to assess the individual effect of intervention modules on the targeted behavioural outcomes (Collins et al., 2014, Chakraborty et al., 2009, Collins et al., 2011). Pregnant smokers are randomly allocated to one of 32 experimental groups in a 2^5 (2x2x2x2x2) full factorial design, in which each group receives a combination of the five modules and the different levels of each module. Findings from this study will be used to inform intervention optimization by identifying components and component levels with the most potential to influence behaviour change. The revised intervention will be tested in a second component selection experiment before moving on to full-scale RCT. In addition, automatically collected data on pregnant smokers' engagement with the app and their helpfulness ratings on different intervention components will be evaluated, and a qualitative think-aloud study (Jaspers, 2009) with pregnant smokers will be conducted to explore their perspectives' about the design, content and usability of the first version of the app.

10.5.1. Limitations

The main limitation of the development of this intervention was the limited extent to which pregnant smokers from the target population were actively involved in various stages to contribute to decisions about what to include in the app, how to present the content and in what ways the intervention should be delivered to increase engagement. This was due to time and resource constraints regarding recruiting hard-to-reach pregnant smokers. However, the development of SmokeFree Baby follows a multiphase approach, and as such, it is ongoing; therefore, this issue will be addressed in the future to inform subsequent versions of the intervention.

CHAPTER 11 – GENERAL DISCUSSION

11.1. Summary conclusions of each strand of work reported in the thesis

This thesis reported two strands of work leading to the creation of the SmokeFree Baby smartphone app to help pregnant women tackle their smoking during pregnancy. The first line of research included three studies to examine smoker identity and its role in smoking cessation. Studies 1 and 2 (reported in Chapters 4 and 5, respectively) used data from a national prospective survey of adults in England. Study 1 showed that most smokers do not have a positive smoker identity; however, those who do are less likely to try to quit smoking, independent of other key predictors of quit attempts. Study 2 found that most ex-smokers who quit recently make a mental transition from being a smoker to a non-smoker; however, those who do not adopt a non-smoker identity after a quit attempt are less likely to remain abstinent in the medium term. Study 3 (reported in Chapter 6) was a meta-ethnography of qualitative studies on smoker identity in young adults and found that multiple smoker identities evolve depending on the context, and the nature of a salient smoker identity triggered by particular contexts can play an important role in smoking cessation.

The second strand of work comprised three developmental studies to inform the design and delivery of the SmokeFree Baby smoking cessation smartphone app for pregnant smokers. Study 4 (reported in Chapter 7) used qualitative interviews with pregnant smokers and found that from their perspective, stopping smoking would require greater psychological capability, a more supportive social and physical environment, and change in their beliefs and identity in relation to smoking. Study 5 (reported in Chapter 8) involved focus groups with HCPs and

showed that from their perspective, digital interventions offer a range of potential benefits that would make them useful for pregnant smokers, and specific recommendations regarding the content, design and delivery of such interventions were also identified. Study 6 (reported in Chapter 9) used data from a pilot RCT of the MumsQuit smoking cessation website for pregnant smokers and applied the BCTTv1 to characterise the intervention content by BCTs. This study showed that MumsQuit delivered a number of BCTs from the BCTTv1, six of which were identified as potentially important to be included in digital smoking cessation interventions in order to test their effects on quit success during pregnancy.

11.1.1. Summary of main findings related to smoker identity

Identifying oneself with a particular identity and having positive or negative self-thoughts, self-feelings and self-images attached to that identity have been argued to generate potentially strong motives to perform or change specific behaviours or behavioural patterns (West, 2006b, West and Brown, 2013). This thesis started with examining how this might manifest in relation to a positive smoker identity and quit attempts and quit success in a nationally representative sample of smokers in England (Study 1 in Chapter 4). This study supports previous findings in the literature in that only a small proportion of smokers had positive feelings attached to their identity as a smoker (Jarvis et al., 2002). Although the prevalence of a positive smoker identity was low in absolute terms across age, gender and social grade groups, it was found that older age, enjoyment of smoking, stronger nicotine dependence and lower motivation to stop were independently associated with a positive smoker identity. This study expands on previous studies (Falomir and Invernizzi, 1999, Hoie et al., 2010, Moan and Rise, 2005, Song and Ling, 2011, van den Putte et al., 2009) reporting

that those with a smoker identity were less likely to intend to quit, and it showed that having a positive smoker identity deterred smokers from making a quit attempt by the six months follow-up. The prediction was significant after adjusting for key variables that have been previously found to predict quit attempts, such as health concerns and enjoyment of smoking (Vangeli et al., 2011, McEwen et al., 2008). However, the prospective predictive relationship between positive smoker identity and quit success at six months was not statistically significant.

It has been proposed that identity not only is a source of potentially strong motives but provides a basis for self-control to deliberately regulate one's behaviour in accordance with personal rules to avoid acting on competing impulses and desires (West, 2006b, West and Brown, 2013, Baumeister et al., 1994, Lei Hum et al., 2013); therefore, the thesis continued with assessing the role non-smoker identity could play in sustained behaviour change among those who recently quit smoking (Study 2 in Chapter 5). Based on a nationally representative sample of recent ex-smokers in England, this study showed that the prevalence of a non-smoker identity was high across age, gender and social grade groups, which is in line with previous findings in the literature (Vangeli and West, 2012, Vangeli et al., 2010a, Johnson et al., 2003). Consistent with previous studies, it was also found that increased length of abstinence and younger age were associated with a non-smoker identity following quitting (Vangeli et al., 2010a). The majority of findings relating to post-quit smoker identities and smoking relapse have been reported in qualitative studies (Johnson et al., 2003, Vangeli et al., 2010a, Nichter et al., 2008, Bottorff et al., 2000), and this thesis adds to these by showing that labelling oneself as a non-smoker after quitting smoking independently predicted abstinence at three months follow-up in a population sample.

Complementing the first two quantitative studies in the thesis, the first strand of work ended with a meta-ethnographic synthesis of qualitative evidence on smoker identity and its potential role in cessation (Study 3 in Chapter 6). This study found that young adults could hold multiple smoker identities concurrently, and different smoker identities might be adopted and changed dynamically depending on intrapersonal factors and the social and environmental context. In line with previous quantitative studies, the synthesis showed that identifying oneself as a smoker could be conflicting with other valued identities; therefore, people might deny their smoker identity (Choi et al., 2010, Ridner et al., 2010, Levinson et al., 2007, Berg et al., 2009, Leas et al., 2014). Moreover, it has been proposed that people are motivated to act on the basis of their identities regardless of the potential costs or benefits of the particular behaviour (West, 2006b, West and Brown, 2013, Oyserman et al., 2007, Oyserman, 2007, Oyserman, 2009), and findings from this study support this argument by showing that salient smoker identities triggered by the context could provide strong motivation to engage in behaviours that facilitate or undermine behaviour change in relation to smoking.

11.1.2. Summary of main findings related to the intervention development

Following the principles of the BCW that emphasize the importance of assessing the target behaviour when developing complex interventions and understanding the processes through which the intervention is likely to bring about change in that behaviour (Michie et al., 2014a), developmental studies in this thesis began with an in-depth exploration of pregnant smokers' perspectives about the intrapersonal and extrapersonal factors that would need to change in order for them to stop smoking (Study 4 in Chapter 7). This study used the COM-B model

(Michie et al., 2011d, Michie et al., 2014b) as a coding framework to identify potential intervention targets, and consistent with previous research, it showed that improving pregnant smokers' understanding of the health consequences of smoking during pregnancy (Bull et al., 2007, Gould et al., 2013, Polen et al., 2015), helping them cope with stress and negative emotional states (Al-Sahab et al., 2010, Hauge et al., 2012, Baron et al., 2013, Scott et al., 2009) and giving them advice to avoid social cues for smoking (Hoekzema et al., 2014, Schneider et al., 2010, DiClemente et al., 2000, Ingall and Cropley, 2010) may be important to include in interventions to aid cessation. Additionally, it was identified that improving pregnant smokers' knowledge of available sources of effective smoking cessation support, providing distraction to overcome urges to smoke, and fostering a mental image of becoming a health-conscious person who does not smoke should also be considered in intervention development.

In order to specify additional intervention targets and to inform the development of the SmokeFree Baby smartphone app, the thesis continued with exploring HCPs' perspectives about using digital interventions to engage pregnant women with smoking cessation support and their recommendations for the ways in which such interventions should be designed and delivered (Study 5 in Chapter 8). Adding to the list of previously identified potential benefits of using digital aids with pregnant smokers, such as the convenience and anonymity they afforded users (Naughton et al., 2013b, Herbec et al., 2014a, Szwajcer et al., 2005), HCPs in this study indicated that digital interventions could offer consistent quality of advice and facilitate the uptake of face-to-face support. However, and also consistent with previous research (Naughton et al., 2013b, Herbec et al., 2014a), findings from this study suggest that digital interventions should be provided alongside more intensive forms of behavioural

support, so that pregnant smokers could speak to HCPs face-to-face, benefit from CO-monitoring, and obtain NRT. This study expands on previous studies by identifying a number of specific recommendations for the content (e.g. increase the salience of reasons to quit by fostering emotional bonding with the baby), format and delivery (e.g. provide easy access to face-to-face support) and tailoring of behaviour change messages (e.g. tailor content to the person's confidence in ability to stop smoking) that should be taken into account when developing digital interventions for pregnant smokers.

The third developmental study in this thesis began to explore potentially useful BCTs to deliver selected intervention targets in digital smoking cessation interventions for pregnant smokers by specifying the BCTs in the content of the MumsQuit intervention (Herbec et al., 2014b) and investigating how BCT exposures in this context might be associated with abstinence (Study 6 in Chapter 9). Findings from this study are congruent with previous studies of the general population (Kelders et al., 2012, Ghorai et al., 2014, Eysenbach, 2005) in that engagement with the website was modest, as only half of participants visited MumsQuit more than once. Moreover, it was found that pregnant smokers' engagement with the intervention, both in terms of the mean number of logins and pages viewed, was significantly lower in low socioeconomic groups than in high socioeconomic groups. MumsQuit delivered a range of BCTs mapping on to 15 BCT clusters from the BCTTv1 (Michie et al., 2013a, Michie et al., 2011a); however, participants were only exposed to approximately a third of distinct BCTs that were identified in the intervention content. A preliminary analysis of the unadjusted associations between specific BCTs and abstinence indicated that a number of BCTs might be high-priority candidates for further testing of their

effectiveness, as it was not feasible in this study to disentangle the effects of BCTs from other confounders.

11.2. Practical implications and the SmokeFree Baby app

A number of practical implications can be drawn from the studies reported in the thesis. Primarily, findings from these studies suggest that smoker identities predict quit attempts and people's ability to sustain abstinence; therefore, harnessing identity change, in which positive self-thoughts, self-images and self-feelings attached to a new identity as a non-smoker may be an important target for behavioural interventions aimed at promoting smoking cessation and/or relapse prevention. It needs to be recognized that people can identify themselves with various smoker identities, but it is also possible that they do not consider smoking as important in their self-definition. Therefore, it appears that in cases in which people do not have a well-established identity in relation to smoking, interventions should aim at generating a new sense of self as someone who does not smoke, instead of concentrating solely on the 'smoker' or 'non-smoker' dichotomy and fostering change from one identity to another. This will require developing a reliable measure to assess people's identities in this context in order to inform tailoring the interventions accordingly.

This thesis contributed to the preparation stage in MOST, in which the primarily goal was to select intervention components that could be included in the first version of the intervention to test their effects, and to evaluate whether the app designed around the identified BCTs have sufficient evidence for usability and acceptability to warrant further evaluation of its effectiveness. It was feasible to use evidence both from qualitative and quantitative studies,

and from pregnant smokers and HCPs who work with them to inform the content and design of the app. Depending on the complexity of the programme, digital smoking cessation interventions can be expensive to develop. The SmokeFree Baby app cost approximately £20,000-25,000 only for the app developers' time; however, once developed, there are no additional costs associated with delivering the intervention to the target population as intended.

A screening experiment with five intervention modules is currently ongoing to assess the main effects (the mean difference between factors averaging across all conditions) of individual intervention components (identity vs. stress relief vs. health effects vs. face-to-face support vs. behavioural substitution) in SmokeFree Baby. Using a randomized full factorial design, each module is evaluated in two levels (minimal vs. intensive), resulting in 32 experimental conditions to be tested. Although it would be difficult to carry out this experiment if the intervention was delivered face-to-face, digital interventions are particularly suitable for using factorial design for evaluation, because these programmes allow for a relatively straightforward random allocation of users to treatment groups and for testing a number of conditions simultaneously. A potential disadvantage to be considered during intervention development is that additional developmental costs are associated with programming the app according to the random allocation of participants.

More than half of smokers in the general adult population in England report cutting down the number of cigarettes smoked, and women and young people are more likely to engage with this harm reduction strategy (Beard et al., 2011). The NICE guidance recommends that smokers should be supported in their smoking reduction efforts with or without temporary or

long-term use of NRT, self-help materials, behavioural support (NICE, 2013); however, promoting smoking reduction during pregnancy is still controversial and it is not included in current treatment guidelines for smoking cessation during pregnancy. This may partly be because only a few studies have shown evidence for the health benefits of cutting down during pregnancy, and only in relation to the birth weight of the baby, and also because of the fear of deterring pregnant women from complete cessation that has the greatest potential to reduce the increased health risks. It is argued in this thesis that if the app promotes substantial smoking reduction, this would be expected to mitigate the effect of compensatory smoking. It considers complete smoking cessation as the primary aim of the intervention, but recognizes the importance of tailoring the behaviour change goal to the specific needs of pregnant smokers. If substantial harm reduction can be achieved from the earliest possible moment during pregnancy, it should be encouraged providing that complete cessation is promoted as the ultimate behaviour change goal.

11.3. Limitations

The main limitations of this thesis are summarized as follows. Although the thesis recognizes that people can define themselves on the basis of various identities, such as relating to their professional or personal roles, gender, ethnicity, different social groups to which they belong or activities in which they engage, and that each identity aspect can potentially influence behaviour, studies in this thesis focused solely on smoker identities. This was because of the need to be focused and precise when furthering knowledge of a particular concept in order to investigate its role in smoking cessation. Therefore, considering all other identity aspects and

exploring the roles they might play in this context would not have been possible within the scope of the thesis.

Moreover, any given identity aspect, including smoker identity, encompasses a range of interrelated identity components, such as self-feelings, self-images and self-thoughts, but population studies in this thesis only assessed people's positive feelings attached to a smoker identity and their self-label as a smoker or a non-smoker. In addition, the observational design used in these studies was not suitable to evaluate the relative importance of individual identity components for smoking cessation or relapse. Nevertheless, this thesis reports *prima facie* evidence that smoker identities can influence behaviour and it provides the basis for further investigation of the role different identity components may play in smoking cessation.

In terms of the assessment of identity, the measures in this thesis will clearly not have captured its full complexity. Neither is it known how far self-reports can accurately describe something essential about a person's identity and its components. However, there is a lack of reliable measures of smoker identity in the literature, and although previous studies have used different approaches, such as single-item categorical measures (Choi et al., 2010, Ridner et al., 2010) or a composite measure of smoker identity (Falomir and Invernizzi, 1999), the reliability and validity of these alternative measures have yet to be established.

Another limitation of this thesis is the lack of biochemical verification of smoking status in the studies reported. Although it has been suggested that large-scale population-based studies tend to show low levels of bias in self-reporting of smoking status, using self-report to assess abstinence may be less reliable among pregnant smokers (Benowitz et al., 2002). However,

where self-reported abstinence in pregnancy was included in this thesis, it was in a preliminary assessment of a digital smoking cessation intervention, in which the lack of face-to-face contact might have mitigated any potential bias arising from pregnant smokers' self-report.

The generalizability of the findings in this thesis is limited, partly because all original studies were conducted in England, and all studies that were synthesised in the meta-ethnography were conducted in Western industrialised countries. Moreover, none of the studies in relation to identity were conducted solely among pregnant smokers, because data on participants' pregnancy status were not collected in the Smoking Toolkit Study and only one study of pregnant smokers met the inclusion criteria in the meta-ethnography. In addition, the follow-up samples in the population studies were not selected on the basis of representativeness for the general adult population in England. However, the differences between those who were followed up and who were not followed up in baseline characteristics were generally small in absolute terms with observed statistically significant differences primarily due to the large sample size.

Further limitations include that pregnant smokers were not actively involved in the design and content specification of the app, and the non-experimental way of assessment of individual BCT components was not suitable to evaluate their specific effects for smoking cessation. Finally, various decisions at each step of the intervention development, such as the selection of experimental modules from potentially important candidates, drew on researcher judgment. However, a transparent reporting of the intervention development, including the ways in which judgment has been used to inform the design and content of the app, can

provide basis for evaluating SmokeFree Baby and its components in rigorous experimental studies.

11.4. Future research

More research is needed to advance knowledge of the role identity plays in behaviour change, and the best practice for fostering identity change in order to alter people's behaviour. As a starting point for a better conceptual understanding of identity, theories need to be systematically identified in the literature from a variety of disciplines to synthesise their key tenets in relation to identity, including the components and the mechanisms by which identity components interact with each other and with behaviour. The ultimate aim would be to develop an overarching cross-domain theory that incorporates all important identity components identified in relevant theories. A comprehensive theory can be used to inform the development of new methods to precisely measure the components of any given identity aspect, such as a smoker identity, so that they are interpretable and testable.

Both experimental and prospective studies are needed in the future to evaluate the specific effects of individual identity components, their interaction, and change in dose over time. If effective, identity components could be strategically targeted in complex interventions, such as in digital interventions to aid smoking cessation. For example in smartphone apps, a potential way of implementing this may involve developing a specific intervention module or an app feature within that module, which would be designed around BCTs to specifically target a selected identity component, such as to increase the salience of self-views related to an aspirational identity.

Bringing about change in people's identities may pose a challenge to behavioural scientists developing complex interventions given that there is no established way of achieving this nor to measure it. The 'identity' cluster in the BCTTv1 comprehensive taxonomy (Michie et al., 2011a, Michie et al., 2013a) encompasses five BCTs to influence identity as part of a behaviour change strategy, such as drawing the person's attention to self as a role model or to discrepancies between self-images and current behaviour, and advising the person to construct a new mental image as someone who used to engage with the unwanted behaviour. However, we do not know how far these BCTs can influence deep change in people's identity. Therefore, further research is needed to investigate alternative strategies to foster identity change, such as by targeting specific identity motives to drive new identity definition (Vignoles, 2011, Vignoles et al., 2006b), or developing a brand identity around a health behaviour change intervention, such as the SmokeFree Baby app, to create an aspirational identity as someone who uses the app and/or adheres to its key principles when formulating personal rules (e.g. not smoking in front of children).

Future research is needed to explore the extent to which SmokeFree Baby is acceptable and engaging among pregnant smokers in England. The 'person-based' approach to developing digital health behaviour change interventions (Yardley et al., 2015), suggests that the refinement of the app should be informed by a better understanding of potential users' demographic and smoking characteristics as well as their experiences with SmokeFree Baby. It also needs to be evaluated whether and in what ways any effective app could be implemented into routine smoking cessation treatment during pregnancy. Finally, future studies would be needed to investigate whether an effective version of SmokeFree Baby could be adapted to countries where resources are not available to invest in the development

of expensive smartphone apps for smoking cessation. If core intervention modules delivering transferable content could be identified, adapting the intervention to be suitable for pregnant smokers from different geographic areas would probably save time and require less resource.

SmokeFree Baby has been designed as a fixed intervention, meaning that the content and intensity of the support do not vary based on participants' characteristics or progress with their selected behaviour change goal. Future research is needed to identify variables to tailor the intervention to the individual's needs. The Sequential Multiple Assignment Randomized Trial (SMART) design (Collins et al., 2007) has been proposed as a framework for developing time-varying adaptive interventions. Similar to MOST, SMART involves a randomized experimental design developed specifically to identify tailoring variables and decision rules to be implemented in adaptive interventions, which can be tested in a RCT. It is suggested that SMART can be used following or in conjunction with intervention optimization in MOST (Collins et al., 2007). Therefore, SMART may be useful to identify tailoring variables for pregnant smokers (e.g. confidence in ability to stop, shift in smoker identity, experience with face-to-face support or change in initially selected behaviour change goal), specify the optimal sequencing of intervention components within each module and use a time-varying adaptive version of the app as a comparative intervention to evaluate the effectiveness of SmokeFree Baby to increase the number of smokefree days during pregnancy and potentially to improve birth outcomes (e.g. increased birth weight).

11.5. Final remarks

The intervention development set out in this thesis can form the basis for optimizing a smoking cessation smartphone app (SmokeFree Baby) in order to provide effective support for pregnant smokers who want to tackle their smoking during pregnancy. The thesis also contributes to a better understanding of identity as an important motivational influence on people's smoking behaviour and it proposes possible ways in which identity change can be harnessed as part of a behaviour change strategy in digital interventions for smoking cessation. It is hoped that future research will further investigate the role of identity in health behaviours and advance intervention science to inform the development of interventions that can effectively target the different contributors to behaviour change.

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Appendix C-4: List of excluded papers from the meta-ethnography with reason for exclusion after full-text screening

Author, year	Reason for exclusion
Afifi Soweid et al., 2004	Religious identity: This quantitative study assessed the extent to which people's religious identity is associated with their smoking behaviour.
Alexander et al., 2010	Gender identity: This study explored young people's views on gender identities and smoking behaviour.
Aloise-Young and Hennigan, 1996	The paper reports quantitative evidence on smoker identity; participants' age: 5th-8th graders
Aloise-Young and Graham, 1996	The paper reports quantitative evidence on smoker identity; participants' age: 5th-8th graders
Amos et al., 2007	Gender identity: The study explored young people's (age 15-16) views on their gender identity and the meanings they attach to their smoking.
Amos et al., 1998	The paper reports quantitative evidence on smoker identity; participants' age: age 12-19
Amos et al., 1997	The paper reports quantitative evidence on smoker identity; participants' age: age 12-19
Angstman et al., 2009	Ethnic identity: The study assessed the relationship between identification as an American Indian and smoking behaviour.
Asbridge et al., 2005	Ethnic identity: The study assessed the relationship between ethnic identity and smoking behaviour in young people (age 13-19).
Aycan et al., 1998	Ethnic identity: The study assessed the relationship between acculturation and smoking behaviour.
Barger, 2008	Ethnic identity: This quantitative study assessed the relationship between ethnic identity and smoking behaviour.
Berg et al., 2009	The paper reports quantitative evidence on smoker identity.
Biddle et al., 1985	The paper reports quantitative evidence on smoker identity; participants' age: age 12-18
Bland et al., 1975	The paper reports quantitative evidence on smoker identity; participants' age: age 10-11
Bottorff et al., 2000	Participants' age: age 18-39
Bottorff et al., 2006	Participants' age: age 20-49
Brook et al., 2010	Ethnic identity: This quantitative study assessed the relationship between young African-Americans' and Puerto Ricans' views on ethnic identity and smoking behaviour.
Burton et al., 1989	Participants' age: 7th graders
Cassidy, 2006	Smoker identity was not investigated beyond the assessment of smoking status: This qualitative study assessed the relationship between perceptions of mobile phone use in the context of social identity and adolescent smoking.

Author, year *(Appx. C-4 continued)*	**Reason for exclusion**
Castro et al., 2009	Ethnic identity: This quantitative study assessed the influence of aspects of cultural identity on self-efficacy and the perceived benefits of smoking.
Chae et al., 2008	Ethnic identity: This quantitative study assessed the relationship between self-report of ethnic specific discrimination with current smoking.
Chang, 2007	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the congruency between ideal self-images of smokers and non-smokers and the perceived images of smokers portrayed in cigarette advertisements.
Chassin, 1981	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the relationship between self-perceptions, perceptions of stereotypic male/female smokers/non-smokers and the association with intention to smoke.
Choi et al., 2010	The paper reports quantitative evidence on smoker identity.
Cooper, 1989	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the social image of the young female smokers in female smoker and non-smoker college students.
Dal Cin et al., 2007	Smoker identity was not investigated beyond the assessment of smoking status: The study examined whether identification with a smoker character increases the implicit associations between self and smoking. Half of the participants never smoked.
Davey et al., 2012	Participants' age: age 12-13.
Denscombe, 2001	Participants' age: age 15-16
Eiser et al., 1978	Smoker identity was not investigated beyond the assessment of smoking status. The paper reports quantitative evidence in participants aged 18-54.
Eiser et al., 1977	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed smokers' and non-smokers' attitudes towards cigarette smoking and their perceptions of smokers.
Elkind, 1985	Gender identity: The study explored the social interpretations of female smoking behaviour.
Epstein et al., 1998	Ethnic identity: The study assessed the relationship between Hispanic acculturation and smoking behaviour.
Evans et al., 1990	Gender identity: The study assessed the relationship between being characterised as androgynous and smoking behaviour.
Evans et al., 2006	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the relationship between social images of smokers, social environment and adolescent smoking.

Author, year *(Appx. C-4 continued)*	**Reason for exclusion**
Falomir et al., 1999	The paper reports quantitative evidence on smoker identity.
Falomir-Pichastor et al., 2007	The paper reports quantitative evidence on smoker identity; participants' age: age 11-15
Farrimond et al., 2010	Participants' age: age 20-59
Fidler and West, 2009	The paper reports quantitative evidence on smoker identity; participants' age: age 16-65+
Freeman et al., 2001	The paper reports quantitative evidence on smoker identity.
Friebely et al., 2013	The paper reports quantitative evidence on smoker identity.
Fuqua et al., 2012	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the relationship between multiple peer group self-identification and smoking behaviour.
Gerrard et al., 2005	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the relationship between children's images of smokers and the onset of smoking.
Gilbert, 2007	Gender identity: The study explored whether smoking constitutes part of women's gender identity.
Grube et al., 1984	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the similarity between value images of smokers and non-smokers.
Harris et al., 2008	The paper reports quantitative evidence on smoker identity.
Hassandra et al., 2011	Participants' age: age 10-18; mostly non-smokers
Hertel et al., 2012	The paper reports quantitative evidence.
Hoek et al., 2012	The study explored young adults' perceptions about images associated with tobacco brands and possible effects of plain packaging on the social meaning of cigarette brands. More than half of the participants were non-smokers and it is not evident whether they were ever smokers.
Hoek et al., 2011	The paper reports quantitative evidence on smoker identity in terms of adult smokers' and non-smokers' (age 12-24) identification with role models in anti-tobacco campaigns.
Hoie et al., 2010	The paper reports quantitative evidence on smoker identity.
Horneffer-Ginter, 2008	Smoker identity was not investigated beyond the assessment of smoking status: The paper addressed the topic of possible selves in relation to smoking.
Ioannou, 2010	Participants' age: age 15-17.
Koblitz et al., 2009	The paper reports quantitative evidence on smoker identity.
Kong et al., 2012	Ethnic identity: The study assessed the relationship between aspects of ethnical identity and smoking behaviour.
Lee, 1989	Smoker identity was not investigated beyond the assessment of smoking status: Images of male and female smokers held by students were assessed as a function of their smoking status.
Lee et al., 2011	Participants' age: age 12-16.
Lee et al., 2013	The paper reports quantitative evidence on smoker identity.
Legge Muilenburg et al., 2006	Participants' age: children at middle school age

Author, year *(Appx. C-4 continued)*	**Reason for exclusion**
Levinson et al., 2007	The paper reports quantitative evidence on smoker identity.
Lloyd et al., 1997	Participants' age: age 11-16.
Lucas and Lloyd, 1999	Participants' age: age 11-16.
Mao et al., 2013	The study explored female non-smokers' views on male smoking in China.
McCool et al., 2003	Smoking identity was not investigated: The study explored adolescents' interpretation of smokers' images in popular films; participants' smoking status was not assessed.
McCool et al., 2013	More than half of the sample consisted of non-smokers and it was not reported whether they were ever smokers at the time of enrolment.
McInman, 1991	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed multiple dimensions of self-concept in relation to smoking.
McKennell, 1969	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed adolescents' ratings regarding their views on 'the boy-smoker', 'the boy non-smoker', 'the self' and 'the ideal self' on a 19-item bipolar scale to conduct factor analysis.
Mermelstein, 1999	Participants' age: age 11-19.
Michell, 1997	Participants' age: age 11-13.
Moan and Rise, 2005	The paper reports quantitative evidence on smoker identity.
Moan and Rise, 2006	The paper reports quantitative evidence on smoker identity; participants' age: age 13-14
Moran et al., 2012	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the relationship between young people's identification with different social groups and the effects of anti-tobacco campaign.
Mosbach, 1988	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the relationship between peer group identification and smoking.
Nguyen et al., 2012	Ethnic identity: The study assessed the influence of experiences of racial discrimination and ethnic identity on prenatal smoking.
Nichter et al., 2008	Participants' age: age 18-43.
Nichter et al., 2007	Participants' age: age 18-43.
Odgen et al., 1997	The paper reports quantitative evidence on smoker identity.
Okoli et al., 2011	The paper reports quantitative evidence on smoker identity; participants' age: age 12-19.
Okoli et al., 2008	The paper reports quantitative evidence on smoker identity; participants' age: age 12-19.
Oliffe et al., 2012	Smoker identity was not assessed: The study explored men's perspectives on gender-sensitive health promotion programmes.

Author, year *(Appx. C-4 continued)*	**Reason for exclusion**
Parker et al., 1998	Ethnic identity: The study assessed the relationship between ethnic identity as an African American or a Latino and smoking behaviour.
Phua, 2013	The study reports quantitative evidence to assess whether the identification with social groups can moderate the relationship between group norms and smoking cessation self-efficacy.
Piko and Gibbons, 2007	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed adolescents' views on smoker prototypes as a function of smoking status.
Plumridge et al., 2002	Participants' age: age 13-14.
Remafedi et al., 2008	Sexual identity: The study assessed the relationship between different sexual identities and smoking behaviour.
Ridner et al., 2010	The paper reports quantitative evidence on smoker identity.
Ritchie et al., 2010	Participants' age: age 18-60+.
Rugkasa et al., 2003	Gender identity: The study explored young people's perceptions of gender identity and smoking.
Scheffels and Lund, 2005	Smoker identity was not investigated beyond the assessment of smoking status: The paper addressed the topic of smoking motivations and confidence in ability to stop smoking as a function of smoking status.
Schofield et al., 2001	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the relationship between favourable smoking norms in the peer group and smoking behaviour.
Shadel and Tharp-Taylor, 2009	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed adolescents' (age 11-17) identification with role models in anti-tobacco messages.
Shadel and Abrams, 2004	The study assessed never smokers' identification with smokers in cigarette advertisements.
Shadel and Abrams, 2004	The study assessed the relationship between self-conflicts and the identification with smokers from cigarette advertisements in never smokers.
Shadel et al., 2008	The study assessment the relationship between identification with smokers from cigarette advertisements, aspects of self-concept and intention to smoke in never smokers.
Shadel et al., 2009	The study assessed the relationship between exposure to cigarette advertisements and intention to smoke in never smokers.
Song et al., 2013	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the association between exposure to possible future selves by using avatars in computer games and attitudes toward smoking.
Soweid and Salem, 2004	Religious identity: The study assessed the relationship between religious identity and smoking behaviour.

Author, year *(Appx. C-4 continued)*	**Reason for exclusion**
Spijkerman et al., 2005	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the relationship between adolescents' perceptions of smoker prototypes and smoking onset.
Sussman et al., 1994	Smoker identity was not investigated beyond the assessment of smoking status: The study assessed the relationship between identification with social groups and smoking behaviour, but the analysis did not go beyond assessing smoking status (i.e. did not assess smoker identity).
Thompson et al., 2009	Participants' age: age 20-73.
Tracy et al., 2012	The paper reports quantitative evidence on smoker identity.
Treacy et al., 2007	Participants' age: age 11-16.
Vahey et al., 2010	Smoker identity was not investigated beyond the assessment of smoking status: An implicit association test was conducted with social identity and smoking.
van den Putte et al., 2009	Participants' age: age 16-70.
van der Heiden et al., 2013	Participants' age: age 18-48.
Wolsko et al., 2009	Ethnic identity: The study assessed the relationship between cultural identity as a Yup'ik and smoking behaviour.
Young, 1993	Participants' age: age 13-18.

Appendix C-5: List of first order interpretations in the meta-ethnography

ID number of key constructs	First order interpretations	Number of occurrences	Number of studies reporting
89	Identification with a social/casual smoker identity, rather than with a smoker identity.	7	7
67	Being a smoker to gain social benefits (e.g. to help socializing, provide feelings of being included).	7	6
3	Being a smoker means you purchase cigarette on your own rather than borrowing it from others; if not, then not being a smoker.	6	5
18	Being a smoker means you smoke more often; if not, then not being a smoker.	6	5
35	To avoid stigma consciously choose where, when and with whom they smoke or hide being a smoker.	5	5
110	Not being a smoker due to perceived control over smoking.	5	5
46	Identity conflicts due to smoking, because it diminishes current or future identity aspirations.	5	4
139	Being a smoker is an unattractive identity due to stigma and negative social discourse associated with it.	5	4
20	Not having a smoker identity, but smoking when drinking.	4	4
44	Smoking to express an identity, which is in accordance with what is valued by the social group to maintain social status.	4	4
116	Having a non-smoker identity despite smoking cigarettes.	4	4
14	Concern about loosing the social image and social benefits of smoking in case of quitting.	4	3
22	Denial of being a smoker is context dependent; thus, maintaining non-smoker image in front of significant others (e.g. family, employers, strangers), but engaging in smoking with friends.	4	3
82	Smoker identity is not a binary construct; rather multiple smoker identities coexist.	4	3
26	Being a smoker means that smoking involves a large part of life (e.g. need to smoke at certain times), part of daily routine; if not, then not being a smoker.	4	2
4	Identification as a non-smoker undermines desire to quit smoking.	3	3
6	Social smokers want to dissociate negative images of an addicted smoker from themselves	3	3
21	Identity self-label as ‘only social smoker’ to justify smoking.	3	3

ID number of key constructs *(Appx. C-5 continued)*	First order interpretations	Number of occurrences	Number of studies reporting
93	Identification with future smoker or non-smoker identities.	3	3
107	Addicted (daily) smokers have negative social image and are looked down by non-daily smokers.	3	3
111	Not being a smoker due to smoking less than others (even though a person smokes 5-15 CPD).	3	3
113	Not being a smoker due to perceived ease of quitting smoking.	3	3
120	Being a smoker means that one is addicted to cigarette and experiences cravings; if not, then not being a smoker.	3	3
88	Smoker identity is not part of identity.	3	2
103	Choosing a specific cigarette brand to make a statement of one's identity.	3	2
135	Don't want to be seen as a smoker and feelings of guilt and regret are associated with it.	3	2
75	Negative feelings and self-portrayal due to being a smoker.	3	1
9	Rejection of being addicted serves as a tool to maintain identity as a person in control and smoking at the same time.	2	2
23	Smoking to appear someone who is cool and to rebel against good girl identity.	2	2
27	Negative physical (e.g. having yellow teeth, smelling) and psychological characteristics (e.g. anxious) are associated with being a smoker.	2	2
28	Not a smoker because would not smoke alone.	2	2
31	Being an addicted smoker is a feared identity.	2	2
40	Smoking allows being part of the cool group.	2	2
63	Identification with a non-daily/occasional smoker identity as opposed to a smoker identity.	2	2
72	Considerate and inconsiderate smoker identity: Being a considerate smoker is better/superior than being inconsiderate (exposing others to smoking e.g. in pregnancy).	2	2
83	Smoker identity is not a static construct, because there can be a shift between identities.	2	2
84	Central smoker identity can be identified.	2	2

ID number of key constructs *(Appx. C-5 continued)*	First order interpretations	Number of occurrences	Number of studies reporting
90	Being a smoker is seen as something that could be worse by being a pack-a-day smoker, a drug user or an alcoholic.	2	2
94	Being a smoker does not match with other valued identity aspects (e.g. be a good mother, successful), and this motivates making a quit attempt.	2	2
108	Cool smoker identity: Perceived controlled over smoking is part of the identity and image as a cool smoker as opposed to addicted smokers.	2	2
112	Not being a smoker because cravings are related to the social aspects of smoking.	2	2
119	The realization that someone is a smoker is associated with an unsuccessful quit attempt.	2	2
73	Being vulnerable to be a smoker again due to perceived benefits of smoking.	2	1
101	Choosing a specific cigarette brand to express group identity.	2	1
105	Choosing a specific cigarette brand to express and upgrade one's social class.	2	1
117	Rules regarding smoking are different when alcohol is involved.	2	1
126	Being vulnerable to smoke again because reasons for not smoking were situational, contextual and influenced by significant others.	2	1
127	Having clear intention to distance themselves from smoker self and smoking, and consciously forming a plan and belief how not to be a smoker again can help individuals to abstain from smoking.	2	1
135	Do not want to be seen as a smoker.	2	1
142	Being a smoker means that you can be looked down on and get labelled.	2	1
1	Regarding oneself as a smoker depends on whether one thinks one is addicted or smokes due to habit.	1	1
2	Being addicted means that someone smokes every day; if not, then not being a smoker.	1	1
5	Being addicted is associated with negative images and feelings (e.g. being desperate, having cravings).	1	1
7	Ambivalence whether they see themselves as addicted.	1	1

ID number of key constructs *(Appx. C-5 continued)*	First order interpretations	Number of occurrences	Number of studies reporting
8	Thoughts about whether someone is addicted are hard to articulate.	1	1
10	Perceived control over smoking; thus, not being addicted to smoking.	1	1
11	Those accepting being addicted do not hold future non-smoker identity.	1	1
12	Not seeing oneself as a non-smoker in the future due to unsuccessful previous quit attempts.	1	1
13	Realisation of being addicted is associated with a quit attempt and how hard it was.	1	1
15	Being a smoker is part of adult identity, so the person holds future smoker identity and does not want to quit.	1	1
16	Not being a smoker because 'never gasping'.	1	1
17	Constructing a smoker identity that is based on being informed about the health risks undermines any desire to quit smoking.	1	1
19	Smoking communicates that a person is fun loving and takes pleasure over health awareness.	1	1
24	Being a smoker means you started smoking long ago; if not, then not being a smoker.	1	1
25	Being a smoker to be seen as a more relaxed person in the future.	1	1
29	Being a smoker is an unattractive identity; therefore, want to stop.	1	1
30	Do not smoke every day due to the importance of self-appearance.	1	1
32	Dependence is a negative trait that distinguishes smokers from occasional smokers.	1	1
33	Formulating personal non-smoking rules around life events: 'Would not smoke if had a child'.	1	1
34	Being a smoker does not cause dissonance with other identities and feeling of stigma when drinking with others.	1	1
36	Being a smoker is cool with other smokers but something that needs to be hidden in front of non-smokers (dual image of smoking).	1	1
37	Smoking to increase self-confidence in public situations.	1	1
38	Being a smoker is a statement of glamour.	1	1
39	Smoking to construct self-image of a sophisticated person.	1	1
41	Smoking to look sexy.	1	1

ID number of key constructs *(Appx. C-5 continued)*	First order interpretations	Number of occurrences	Number of studies reporting
42	Smoking to achieve an ideal self.	1	1
43	Smoking to form a mature identity.	1	1
45	Demarcation strategies to avoid smoker identity.	1	1
47	Smoking socially is a short-term indulgence, while addicted smokers smoke permanently.	1	1
48	Smoking to look more elegant.	1	1
49	Being successful is an aspired future identity, which is conflicting with being a smoker in the future.	1	1
50	Immediate social acceptance from the group and disapproval from the wider context creates tension.	1	1
51	Do not enjoy smoking or anticipate smoking situations, but this is a price to be paid for social acceptance.	1	1
52	Consuming alcohol liberates smokers from their non-smoker identity and reconcile dissonance what normally would keep them away from smoking.	1	1
53	Internal conflicts due to dual smoker identities were managed by reducing the salience of these conflicts.	1	1
54	Performative smoker identity: mainly related to smoking initiation.	1	1
55	Internal conflicts due to perceived superior status as a non-smoker but engaging in a stigmatized behaviour.	1	1
56	Construct a smoker identity as a defensive community against stigmatization.	1	1
57	Rationalisation (i.e. smoking is not a rational choice when consuming alcohol) to maintain dual identities as a non-smoker who smokes.	1	1
58	Formulating personal smoking rules around alcohol consumption, such as ‘I don’t smoke until I get drunk", to manage internal conflicts.	1	1
59	Perceived benefits of being in a group outreached the risk they are aware of taking with continuing smoking.	1	1

ID number of key constructs *(Appx. C-5 continued)*	First order interpretations	Number of occurrences	Number of studies reporting
60	Defensive mechanism: being a smoker is a rational decision and the risks are within the acceptable range.	1	1
61	Smoking is part of identity as a young person.	1	1
62	Smoking is perceived as something that comes with certain benefits.	1	1
64	Identification with a defensive or negotiating smoker identity.	1	1
65	Having a vulnerable non-smoker identity associated with feelings of desire to smoke due to social pressure.	1	1
66	Having a confident non-smoker identity means you smoked for a while, but then stopped for good.	1	1
68	Having an ardent non-smoker identity means the person completely rejects tobacco and smokers.	1	1
69	Being someone who could quit and does not want to smoke any more gives strengths and feeling of coolness.	1	1
70	Having an accepting non-smoker identity means you do not see yourself as being vulnerable to smoking and therefore do not mind to be around smokers.	1	1
71	Those with an in-control smoker identity see themselves as smokers but only in certain situations.	1	1
74	For confirmed smokers, smoker identity is something that is adopted by time ('becoming a smoker') and acceptance of smoker identity seems to be unquestioned.	1	1
76	Those with a strong smoker identity have vague plans about how to stop in the future.	1	1
77	Those with a strong smoker identity claim they cannot be pressured to quit unless they want to.	1	1
78	Contrite smokers: societal messages prompted smokers to feel regret for their habit. They do not want to be smokers and do not want to be seen as smokers.	1	1
79	Need to strongly believe to be able to be a non-smoker to quit smoking for good.	1	1
80	External regulations in social context would be needed to reassert non-smoker identity and diminish identity conflict (i.e. being a smoker vs. non-smoker).	1	1
81	Having multiple smoker identities does not necessarily cause tension, rather let people act context dependent.	1	1

ID number of key constructs *(Appx. C-5 continued)*	First order interpretations	Number of occurrences	Number of studies reporting
85	Different agents underlie different smoker identities.	1	1
86	Confident non-smokers have active agent in the creation of their smoker identity, whereas others portrayed themselves as passive without choice or control.	1	1
87	Intervention that increases incoherence between self-image and smoking is seen to motivate smoking cessation.	1	1
91	Being a smoker gives feeling of superiority above other substance users.	1	1
92	Being a smoker is a relief because it helps not being involved in criminal acts.	1	1
95	Smoker identity is something that is performed and also that is experienced (becoming).	1	1
96	Rationalization why not being a smoker evolves over time and the definition of smokers always serves one's interest as not being seen oneself as a smoker.	1	1
97	Smoking means being and becoming someone as well as being with someone.	1	1
98	The realization of being addicted means the construction of smoker identity.	1	1
99	Smoking as an identity trademark.	1	1
100	Unanticipated addiction among social smokers creates identity conflict between being a smoker and other lifestyle choices (e.g. being an athlete).	1	1
102	Choosing a specific cigarette brand to negotiate a more individual identity.	1	1
104	Choosing a specific cigarette brand to express an identity that refers to geographic locality.	1	1
106	Being addicted means that one experiences the need to have a cigarette; if not, then not being a smoker.	1	1
109	In an attempt to avoid becoming addicted, one is controlling oneself in terms of when and how many cigarettes he/she smokes.	1	1
114	Not seeing oneself as a non-smoker in the future due to strong need to smoke.	1	1
115	The realisation that someone is addicted is associated with smoking not being social any more and not confining to particular places and context.	1	1
118	The realization that someone is a 'proper smoker' is associated with buying one's own cigarette.	1	1

ID number of key constructs *(Appx. C-5 continued)*	First order interpretations	Number of occurrences	Number of studies reporting
121	Choosing light cigarettes and feminine brand to express gender identity as a women.	1	1
122	Negative health effects are not seen as personally relevant due to being an occasional smoker.	1	1
123	Multiple dimensions of smoker identities exist.	1	1
124	Being vulnerable to smoke again due to stopping was not grounded in strong personal conviction about the need to avoid or abstain from smoking.	1	1
125	Having 'not a complete non-smoker identity' opens the possibility for smoking in the future.	1	1
128	Never wanted to take on the smoker identity and knew consciously that did not want to be a smoker helped abstain from smoking.	1	1
129	Accepting smoker identity and the realization of all the negative health effects, costs and the effects smoking has on appearance.	1	1
130	Smokers tend to be looked as 'stupid' by others; therefore, smoking is not something participants were proud of despite enjoy it.	1	1
131	Concerns about moving between smoking and non-smoking spaces (e.g. going out to have a cigarette; then coming back into the bar) related to bodily signs of being a smoker (e.g. the smells associated with it).	1	1
132	Not being able to smoke inside requires a greater need to manage smoking in relation to presentation of self.	1	1
133	The rearrangement of smoking space (e.g. introducing outdoor spaces, beer gardens) allows young smokers to produce a positive, fun and sociable smoker identity.	1	1
134	Smoking is shaping smokers' nighttime selves and activities.	1	1
136	Smoking is not considered as an acceptable part of one's professional self; thus, hiding being a smoker in front of customers and colleagues.	1	1
137	Smokers belong to social groups with high smoking prevalence; thus, smoking represents a badge of group membership and contributes to social identity.	1	1

ID number of key constructs *(Appx. C-5 continued)*	**First order interpretations**	**Number of occurrences**	**Number of studies reporting**
138	Smokers experienced external disapproval; thus, modified their behaviour to avoid others' judgement.	1	1
141	Being a smoker to look cool and to express a cultural identity of rebellion and notoriety.	1	1
140	Identification with a group of smokers as opposed to the conformist non-smokers group.	1	1
143	Purposefully shifting their identities context to context.	1	1

Appendix D – Chapter 7

Appendix D-6: Interview schedule used in Study 4

Opening question	- "I understand that you are interested in stopping smoking. Please tell me a bit about yourself and any thoughts you have about smoking." - "What would you need to stop smoking?
To explore physical and psychological capability in relation to smoking and cessation	- "How do you feel about how difficult or easy it would be for you to stop smoking?" - "How do you feel about your ability to stop?" - "What would help you stop?" Probes: o What methods do you use to increase your chance of quitting successfully? o What types of support are available for you? o What strategies do you have to cope with withdrawal/craving/stress/mood changes? - "What would it take you to be confident in that you will not smoke again?"
To explore environmental and social opportunity in relation to smoking and cessation	- "What are the things around you that make quitting smoking more difficult for you? - "And how could your situation be changed to make it easier?" Probes: o How difficult or easy is for you to access to support? o What are the things around you that remind you smoking? o What problems do you have in terms of smoking cessation that are specifically related to pregnancy? - "Who else smokes around you?" Probes: o "How do you feel about it in terms of trying to quit?" - "How would an ideal smoking cessation support be for you?" Probes: o "What do you think about the smoking cessation support currently available for pregnant women?"
To explore automatic and reflective motivation in relation to smoking and cessation	- "What does smoking do for you?" Probes: o "What are the functions of smoking in your life?" - "What has been motivating you to quit smoking?" - "How do you think your partner, family or friends would think about you if you stop?" Probes: o "What does it mean to you personally?" - "Thinking about yourself, what are the things you like the most about yourself/the most proud of, and the things that you like the least about yourself/the least proud of?"

(Appx. D-6 continued)	
To explore automatic and reflective motivation in relation to smoking and cessation	- "How do you see yourself with regards to smoking?" Probes: o "How do you feel about it?" o "Any changes in terms of your thoughts and feelings about smoking now that you are expecting a baby?" o "How do you feel about becoming a mum?" - "How would you imagine yourself as a non-smoker?" Probes: o "What difference it would make in your life?" o "How would your thoughts and feelings change?" o "How do you see your baby's life if you were a non-smoker?" - "Have ever thought about how would quit smoking? If so, how?"
Ending the interview	- "Is there anything else you would like to mention or emphasise?" - "Do you have any questions regarding the interview and/or the research?"

Appendix E-8: Interview schedule used in Study 5

Opening question (1-2 min)	-	"Name tags have been given to everyone, now let's find out a little bit more about each other by going around quickly. Please tell us your name and where you work."
Introductory questions (~ 3 min per each)	-	"What do you think is particularly problematic with providing smoking cessation support for pregnant smokers as opposed to the general population?"
	-	"When you come across the phrase: 'digital smoking cessation interventions' what sort of things come to your mind?"
	-	"How do you think any of these digital interventions could address the problems mentioned before?"
	-	"What are your general views on these kinds of interventions?"
	-	"If you think about your work with pregnant smokers, for which aspects of your work do you think digital smoking cessation interventions could provide an alternative to face-to-face support?"
Translational question (~ 3 min)	-	"Let me show you how previously developed digital smoking cessation interventions work in the real world [guiding participants through SF-28 and MumsQuit]."
	-	"What thoughts come to your mind regarding these interventions?"
Key questions (~ 10 min per each)	-	"If you were to design a website that is dedicated to provide smoking cessation support for pregnant smokers, what do you think should definitely be included?" Probes: o Content, design, mode of delivery and language used/communication style
	-	"If you were to design a mobile application that is dedicated to provide smoking cessation support for pregnant smokers, what do you think should definitely be included?" Probes: o Content, design, mode of delivery and language used/communication style.
	-	"If you were to design a text-messaging service that is dedicated to provide smoking cessation support for pregnant smokers, what do you think should definitely be included?" Probes: o Content, design, mode of delivery and language used/communication style.
	-	"Which characteristics of pregnant smokers do you think a digital smoking cessation intervention should be tailored to?"
Ending question (1-2 min)	-	"Is there anything else you would like to mention or add to today's discussion?"

Appendix E-9: List of sub-themes identified in the verbatim accounts of health care providers participating in the focus groups in Study 5

ID number of sub-themes	Sub-themes
1	Denial of the health effects of smoking on the baby
2	Pregnant smokers often find it more difficult to cope with withdrawal; it needs to be addressed
3	Digital interventions should address negative preconceptions of smoking cessation support
4	Digital interventions should address the question of cannabis use
5	Digital interventions should avoid using jargon/ease of language
6	Digital interventions should be linked with telephone support for a personal contact
7	Digital interventions should be provided in addition to face-to-face behavioural support with medication
8	Digital interventions should be tailored to the individual's level of dependence, motivation to stop and confidence in ability to stop
9	Digital interventions should be tailored to the individual's needs for information
10	Digital interventions should be tailored to the individual's preference for the frequency of the messages
11	Digital interventions should be tailored to the individual's preference for the number of messages
12	Digital interventions should communicate unified messages about smoking cessation in pregnancy
13	Digital interventions should engage partners and address second-hand smoke exposure
14	Digital interventions should fit into the individual's daily routine
15	Digital interventions should include build-in tools (e.g. games, saver calculator, daily tips, FAQ, 'myths-busters')
16	Digital interventions should include less text and more visuals/avoid information overload
17	Digital interventions should include visuals related to the pregnancy, but not too 'baby-like'
18	Digital interventions should increase awareness of and motivation to use NRT
19	Digital interventions should link the journey of smoking cessation with the journey of pregnancy
20	Digital interventions should link up with stop smoking advisers (e.g. chat) and local Services
21	Digital interventions should make the intervention available in languages other than English
22	Digital interventions should match up with current pregnancy stage

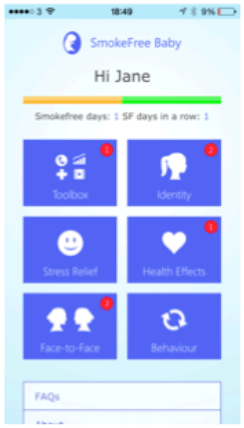
ID number of sub-themes	**Sub-themes** *(Appx. E-9 continued)*
23	Digital interventions should monitor and provide feedback on any changes and progress (e.g. motivation, confidence, dependence)
24	Digital interventions should offer the option of peer-support and link with social media
25	Digital interventions should personalize the messages by including the user's name
26	Digital interventions should provide additional messages on specific dates (e.g. quit date) and follow-up motivational messages
27	Digital interventions should provide additional support in case of relapse
28	Digital interventions should provide an interactive interface
29	Digital interventions should provide details about the support offered
30	Digital interventions should provide feedback with the user's own words
31	Digital interventions should provide other behaviour change messages (e.g. make small changes in daily routine)
32	Digital interventions should provide reinforcements (e.g. collectable rewards, other incentives)
33	Digital interventions should send messages from a known number
34	Digital interventions should strengthen mother-identity and connection to the baby
35	Digital interventions should strengthen non-smoker identity
36	Digital interventions to address second-hand smoking and smoke-free homes
37	Digital interventions to address the lack of physical capability to attend the appointments
38	Digital interventions to address the lack of/inadequate knowledge about smoking/smoking cessation in pregnancy to provide backup for face-to-face support
39	Digital interventions to avoid issue of shame/fear of being judged
40	Digital interventions to be cost effective for NHS
41	Digital interventions to facilitate initial assessment
42	Digital interventions to facilitate making an appointment
43	Digital interventions to give support for those who would not turn up for a second appointment
44	Digital interventions to help distract smokers from cravings
45	Digital interventions to provide a tool for relapse prevention
46	Digital interventions to provide an alternative support
47	Digital interventions to provide anonymity
48	Digital interventions to provide more intensive/additional motivational support
49	Digital interventions to reach a wider population
50	Disadvantaged socioeconomic background would be a barrier to use digital interventions
51	Do not admit being a smoker due to negative feelings about being judged/given a lesson
52	Do not use self-help materials

ID number of sub-themes	**Sub-themes** *(Appx. E-9 continued)*
53	Do not want to engage in group support
54	Feeling of quilt due to smoking in pregnancy
55	Hard to reach pregnant smokers
56	Have to be treated gently to engage with the Services
57	HCPs have to fit around pregnant smokers' lifestyle/daily routine
58	Highly motivated smokers would use digital interventions
59	Home visits/intensive one-to-one support are required
60	Importance of building up a rapport/trust in HCPs
61	Importance of self-care has to be instilled
62	Information overload at booking/later visits; it needs to be avoided in digital interventions
63	Issues with connecting to pregnancy/baby
64	Lack of adequate CO validation, lack of monitoring in digital interventions
65	Lack of CO monitoring as a motivation tool in digital interventions
66	Lack of knowledge about the health effects of smoking
67	Lack of knowledge of medications and how to use them during pregnancy
68	Lack of motivation to use medication (i.e. NRT) in pregnancy
69	Lack of personal contact in digital interventions
70	Lack of physical capability to engage with the NHS Stop Smoking Services
71	Lack of unified messages about smoking cessation in pregnancy across different HCPs
72	Lack of/low motivation to quit smoking
73	Language problems with non-English speaking smokers
74	Pregnant smokers' lifestyle is chaotic; thus, it is difficult to arrange appointments with them
75	Lot of motivating is required from HCPs
76	Low confidence in ability to stop smoking
77	Mental health problems
78	Misinformation about the effects of smoking cessation
79	Motivated externally to attend the appointments
80	Negative preconceptions about the digital interventions need to be addressed
81	Negative preconceptions due to inadequate communication about the NHS Stop Smoking Services
82	No control over how they use the medications in digital interventions
83	Other issues to be discussed during the appointments
84	Pregnancy and smoking cessation have to be made appealing
85	Pressure on pregnant smokers to make an attempt to quit; this needs to be addressed
86	Problem with getting the free services/medication in digital interventions
87	Problem with the access to digital devices in digital interventions
88	Requires strong determination and self-discipline to follow the digital programme
89	Shift workers would use digital interventions

ID number of sub-themes	Sub-themes *(Appx. E-9 continued)*
90	Small proportion would engage with digital interventions
91	Pregnant smokers often smoke more during pregnancy; this needs to be addressed
92	Smokers before pregnancy would use digital interventions
93	Smokers for whom smoking is the norm would not use digital interventions
94	Smokers from more advantage social class, where smoking is a stigma, would use digital interventions
95	Smoking to cope with adverse physical environment; this needs to be addressed
96	Pregnant smokers report strong dependence on cigarettes
97	Pregnant smokers report substance misuse
98	The same HCP is needed for all appointments
99	Time consuming to build up a rapport and trust
100	There is a time pressure on pregnant smokers; this needs to be addressed
101	Users should be provided support without given any personal details in digital interventions
102	Users should not be expected to send or reply to messages in digital interventions
103	Those would use digital interventions who have more confidence in their ability to stop smoking
104	Those would use digital interventions who would be able to quit alone anyway
105	It would be difficult to cover other issues in digital interventions
106	It would be difficult to identify triggers/motivations to smoke in digital interventions
107	Young people would be more likely to use digital interventions

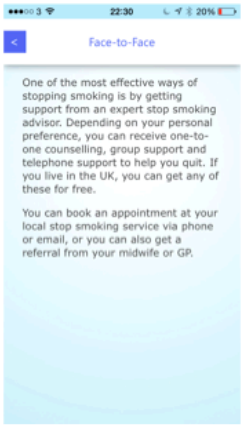
Appendix F – Chapter 10

Appendix F-10: Sample screenshots of SmokeFree Baby

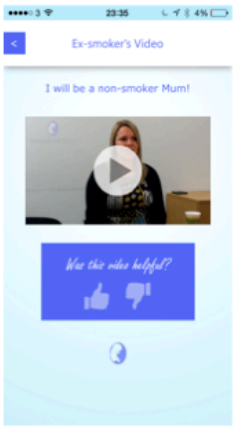


Main dashboard of the app

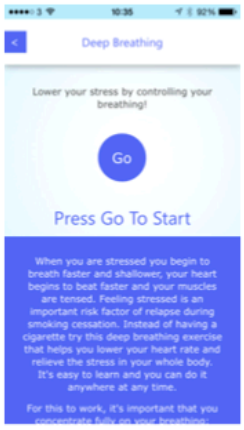
Toolbox features provided for everyone



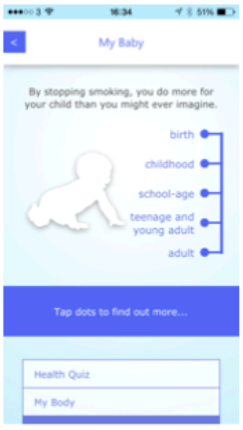
Generic layout of the 'minimal' version of each module



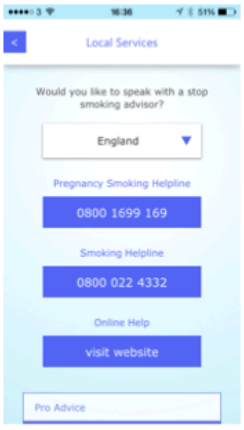
Ex-smoker's videos in the 'Identity' module



Deep breathing exercise in the 'Stress relief' module



Interactive visual in the 'Health effects' module



Links to external stop smoking support in the 'Face-to-face' module

Distraction game in the 'Behaviour' module

Appendix F-11: Content specification of the feedback and monitoring process in SmokeFree Baby

Monitoring of behavioural goal and feedback on progress	
Monitoring 1	Hi [insert participant's name] How are you doing? Did you smoke any cigarettes at all yesterday? ['Yes' and 'No' buttons]
Monitoring 2 [If 'Yes' was selected in Monitoring 1]	How many cigarettes did you smoke yesterday? [Insert option for numerical answer] ['Next' button: go to Feedback 1 or 2]
Feedback 1 [Positive sound if selected goal was met; i.e. complete abstinence for smokefree challenge or no more than 3CPD for cutting down challenge; select messages in order and repeat the cycle]	1. Congratulations! Find out how much money you have saved so far. 2. That's excellent! Take a moment to remind yourself why you want to stop smoking. 3. Good job! You deserve a pat on the back! 4. Well done! As days pass, you're getting better and better at this! 5. That's great, congratulations! You're taking back control of your life from smoking. 6. Carry on, you're doing great! Find a new tip for today in SmokeFree Baby. 7. It might not have been easy, but you did it! Be proud of yourself! 8. Great, keep going! Find out if there's any new content released in SmokeFree Baby for you today. 9. You did it yesterday, and you can do it today too! Browse SmokeFree Baby to find further tips and advice. 10. You can do this! If you haven't done so already, you can tell someone how well you're doing. 11. Well done! Take a moment to think about what helped you stick to your goal yesterday and if you can also do it today. 12. Very good! Treat yourself with something nice, because you deserve it! 13. Your effort really shows! Take a look at your progress bar and find out how far you've come towards your goal. 14. Wonderful! You're making good progress!

Monitoring of behavioural goal and feedback on progress *(Appx. F-11 continued)*	
Feedback 1 *(continued)*	15. Things are going really well. Your friends and family must be very proud of you, and so should you. 16. You are doing really well. You can beat your smoking habit! 17. Terrific! Keep going and leave smoking behind for good. 18. You are making great progress! You will be able to become a non-smoker for good. 19. Excellent! You're on your way to success. 20. It shows that you are managing your cravings very well! Good job! ['Next' button: go to dashboard]
Feedback 2 [Selected motivational feedback in order if behavioural goal was not met; i.e. smoking any cigarettes for smokefree challenge or more than 3CPD for cutting down challenge]	1. You may be a bit disappointed now, but just hang in there. You can achieve your goal today. 2. Don't forget to have someone on speed dial who you can call if things are getting tough and you find it difficult to stick to your goal. 3. Sometimes you may feel that you can't do this, and you would rather have a cigarette. It's all right to be a bit less confident once in a while, but don't give up and keep focusing on why you wanted to quit in the first place! 4. It might be hard to believe at the moment but you have what it takes to stop smoking! Take small steps at a time and concentrate on sticking to your goal today. 5. Don't let this destroy your confidence, because you still have every chance to achieve your goal today. It's important to believe in yourself and keep trying. 6. Beating your smoking habit might not be easy, but it is definitely not impossible: you can do this! Think about the last time you beat your cravings: what helped you back then? 7. The fact that you are keeping up with monitoring your smoking behaviour shows your commitment! Don't let anything distract you from sticking to your goal today. 8. As the Japanese proverb goes: 'Fall down 7 times and get up 8'. So don't give up on yourself and carry on with your goal today! 9. Let go of what happened yesterday. A new day represents a new opportunity: you can successfully stick to your goal today.

Monitoring of behavioural goal and feedback on progress *(Appx. F-11 continued)*	
Feedback 2 *(continued)*	10. You may feel less confident every now and then, but try not to worry too much about yesterday. Just hang in there and concentrate on sticking to your goal today. 11. It's not easy to stay motivated when you're stopping smoking. Sometimes it helps to look back on the commitment you made to yourself when you started SmokeFree Baby and reaffirm it once again. 12. Watch supporting videos from your friends and family in the Toolbox. If you haven't recorded any up until now, this is the perfect time to give it a go. 13. Give yourself another chance today and do everything you can to stick to your goal! ['Next' button: go to dashboard]
Feedback 3 [After first smokefree day]	You did a great job staying away from smoking yesterday. This is exactly what you need to keep doing! Just focus on your goal and stick to it, no matter what. ['Next' button: go to dashboard]
Feedback 4 [After seven consecutive smokefree days]	You've reached your one-week milestone. Sounds like a great achievement! Why don't you think about a reward for yourself if you stick to your smokefree goal for the next 7 days? ['Next' button: go to dashboard]
Feedback 5 [After 14 consecutive smokefree days]	That's impressive! You haven't had a cigarette for 2 weeks now! It's time to reward yourself for your efforts. Keep going and stay focused on your smokefree goal! ['Next' button: go to dashboard]
Feedback 6 [After 28 consecutive smokefree days]	Sensational! You have made it past your 28th consecutive smokefree day! How does that feel? You should be very proud of yourself and your progress. Well done - keep it up! ['Next' button: go to dashboard]
Feedback 7 [After 90 consecutive smokefree days]	Wow! 90 days without smoking is a fantastic achievement! If you maintain this determination you have every chance of stopping smoking for good. ['Next' button: go to dashboard]
Feedback 8 [After 180 consecutive smokefree days]	You should be very proud of yourself! 180 days without smoking really is a great achievement. Keep up the good work! ['Next' button: go to dashboard]

Monitoring of behavioural goal and feedback on progress *(Appx. F-11 continued)*	
Feedback 9 [After 365 consecutive smokefree days]	That's incredible! Celebrate your 1st year of being completely smokefree! ['Next' button: go to dashboard]
Review behavioural goal	
Review goal 1a [If smoking reduction goal was met for 3 consecutive days]	In the last 3 days, you managed to cut down to less than 4 cigarettes per day. Well done, that's a great achievement! ['Next' button: go to Review goal 2a]
Review goal 2a	By stopping smoking, you can completely avoid the effects of smoking on yourself and your baby. As you're progressing very well here, it's a good time to revisit your initial goal and think about stopping smoking completely. You can do this! ['Yes, I am ready to stop smoking completely' button: go to Review goal 3a; and 'Not now' button: go to dashboard]
Review goal 3a [If 'Yes, I am ready to stop smoking completely' is selected in Review goal 2a]	Excellent decision! Visit the Toolbox to find additional tips and advice to help you stick to your smokefree goal. ['Next' button: go to dashboard]
Review goal 1b [If smokefree goal was not met for 3 consecutive days]	It looks like it's been a bit difficult for you recently not to smoke cigarettes, hasn't it? Don't be too harsh on yourself, but take a moment to think about what went wrong. What triggered your smoking and how could you avoid this trigger from now on? ['Next' button: go to Review goal 2b]
Review goal 2b	If you want, you can try to cut down the number of cigarettes you smoke a day before you go completely smokefree. ['No, I want to carry on with stopping smoking completely' button: go to Review goal 3a; and 'Yes, I will cut down to less than 4 cigarettes per day from now on': go to Review goal 3b]
Review goal 3b [If smoking reduction is selected in Review goal 2b]	Your goal has been changed. Make sure that you don't smoke more than 3 cigarettes per day from now on until you are ready to go completely smokefree again. ['Next' button: go to dashboard]

Appendix F-12: Content specification of generic app features in SmokeFree Baby

'FAQs'	
'How often do I need to log in?' [Tap item for content]	To get the most out of the SmokeFree Baby app, we encourage you to log in at least once a day to keep a record of your progress and to receive daily tips and advice. But of course you are welcome to come back here more often!
'What if I'm in an advanced stage of my pregnancy?' [Tap item for content]	You might know that the sooner you stop the better, but don't forget that it is never too late to stop smoking. And if you feel that you can't stop completely, you can still cut down the number of cigarettes you smoke. Either way, you and your baby will benefit greatly both in the short- and long-term.
'How can this app help me?' [Tap item for content]	SmokeFree Baby uses techniques that are based on the latest scientific evidence to help you reduce your motivation to smoke when you're stopping smoking or cutting down. It gives you advice throughout your pregnancy and supports you to do as much as you possibly can to avoid smoking.
'How can I get access to all the content of the app?' [Tap item for content]	All content in SmokeFree Baby is available for free, but you have limited access to particular contents before you start stopping smoking or cutting down. After the date you set for yourself, new content is released on a daily basis.
'What happens after my baby is born?' [Tap item for content]	You can carry on monitoring your progress on stopping smoking or cutting down. You can also benefit from all the content provided here and access any entries you make in the app. And don't forget that all your savings and other benefits will also continue!
'What if I want to start sooner than my selected date?' [Tap item for content]	Go to the main menu and click on the 'Settings' link below. Here you can change any of your settings.
'Why does the app send me push notifications?' [Tap item for content]	We send you motivational messages regularly and we also send you daily reminders if you forget to log in to the app before noon. This is because we suggest that you should make an entry each day in the morning to record any cigarettes you smoked during the previous 24 hours. You can change your settings by going to the main menu and click on the 'Settings' link.
'About'	
'About SmokeFree Baby' [Tap item for content]	SmokeFree Baby is designed to help you give up smoking completely or reduce the number of cigarettes you smoke. We believe that everyone can quit - or at least cut down - and the less you smoke the healthier you will be!

'About' *(Appx. F-12 continued)*	
'The team behind SmokeFree Baby' [Tap item for content]	SmokeFree Baby has been developed by a research team at University College London who specialize in smoking cessation, and built by app developers with expertise in health-related apps.
'The team behind SmokeFree Baby' *(continued)* [Tap photos of team members for details]	Professor Robert West is a psychologist who has been researching into ways to help smokers quit for more than 30 years. He is author of a book for smokers called The SmokeFree Formula. He leads a team of researchers at University College London, advises governments on policy and helped to set up the NHS Stop Smoking Services. Robert smoked for a few years as an adolescent but stopped when his girlfriend at the time strongly objected. He had always intended to stop before it could do too much harm and fortunately had not developed a strong dependence.
	Professor Susan Michie is a psychologist and an expert in behaviour change theory and practice. She has worked with government in developing evidence-based guidelines for smoking cessation. Susan was promised money by her father to not smoke before she was 21. She got the money and has never smoked since.
	Dr Lion Shahab is a psychologist with expertise in tobacco control. He has a particular interest in the development of novel treatments to help people stop smoking. Lion used to be a pack-a-day smoker and successfully stopped a few years ago using a combination of behavioural support and medicine.
	Dr Jamie Brown is a psychologist with expertise in internet-based, learning research. He is especially interested in the role learning plays in addictive behaviours, such as smoking. Jamie stopped in 2009 - he never smoked heavily, but still found it hard to resist smoking when out drinking with friends.
	Ildiko Tombor is a psychologist with expertise in smoking and smoking cessation, and she is the main designer behind SmokeFree Baby. Ildiko never smoked, but her mum was a heavy smoker who only stopped during her pregnancies. She eventually quit after more than 30 years of smoking when Ildiko started to do research into smoking cessation.
	David Crane is a website designer and psychologist with expertise in the design and development of apps that help people change their behaviour.

'Tools to Quit' *(Appx. F-12 continued)*	
'How addicted are you?' [Tap item for content]	Test your addiction to nicotine Nicotine is processed faster in pregnancy, so you might realise that you smoke more frequently than when you weren't pregnant. Find out how dependent you are on nicotine by answering two simple questions. ['Take the test' button] ['Back' button: go to Tools to quit]
'How addicted are you?' *(continued)* [Display results in a diagram with the 6 possible bars and have a different colour for the one that represents the user's result. Display text relevant to the individual' score.]	How soon after you wake up do you smoke your first cigarette? [0: After 60 minutes; 1: 31-60 minutes; 2: 6-30 minutes; 3: Within 5 minutes] How many cigarettes do you smoke a day? [0: 1-10; 1: 11-20; 2: 21-30; 3: 31 or more] ['Submit' button]
	0-1: 'Your score indicates that you have a low level of nicotine addiction. You smoke a few cigarettes a day or you probably only smoke occasionally. You might only smoke when you feel stressed or in social situations. Try out some relaxation techniques and if your smoker friends are around, ask them not to smoke in front of you.' 2-4: 'Your score indicates that you have a moderate level of nicotine addiction. Try different strategies to find out what works for you: make small changes in the part of your daily routine that reminds you of smoking, try out different nicotine replacement products or buddy up with someone to quit together.' 5-6: 'Your score indicates that you have a high level of nicotine addiction. You might want to try out some forms of nicotine replacement products, such as nicotine gums and patches, to help you cope with cravings and get through the first few weeks when withdrawal symptoms are usually the worst.' ['Back' button: go to Tools to quit; and 'More Info' button: go to next page]
	One of the main reasons why people smoke is that they are addicted to the nicotine in tobacco smoke. Just like other drugs, nicotine changes the part of your brain that is responsible for experiencing the feelings of pleasure. It makes you want to repeat smoking in order to experience the same high and to avoid the unpleasant withdrawal symptoms. Nicotine replacement products can help you with your cravings and withdrawal and you can find out more about these in the Toolbox. ['Back' button: go to Tools to quit]

'Tools to Quit' *(Appx. F-12 continued)*	
'Reasons to quit'	List your reasons to quit
[Tap item for content]	When you're stopping smoking, it's not necessarily easy to stay strongly motivated all the time. Keeping your reasons for quitting in your mind can help you remain determined to stick to your goal! What are the reasons why you want to stop smoking? [Insert a recording button and a text field] ['What others say' button: tap to view the next piece of content]
	'I'm worried that smoking is harmful for my pregnancy.' [Insert a 'I feel the same way' button]
	'I worry about the effects smoking has on my baby's health.' [Insert a 'I feel the same way' button]
	'I want to avoid the long-term health risks of smoking.' [Insert a 'I feel the same way' button]
	'I want do something about my wellbeing.' [Insert a 'I feel the same way' button]
	'I don't want discoloured teeth.' [Insert a 'I feel the same way' button]
	'I want to become a non-smoker to be a role model for my child.' [Insert a 'I feel the same way' button]
	'I want to save money.' [Insert a 'I feel the same way' button]
	'I want to look younger.' [Insert a 'I feel the same way' button]
	'I want to be fitter.' [Insert a 'I feel the same way' button]
	'I want to quit, because my partner wants me to.' [Insert a 'I feel the same way' button]
	'I'm quitting smoking, because I had pregnancy complications in the past.' [Insert a 'I feel the same way' button]
	'I'm quitting, because my GP and midwife advised me that I should.' [Insert a 'I feel the same way' button]
	['Back' button: go to Tools to quit]

'Tools to Quit' *(Appx. F-12 continued)*	
'Getting ready'	Be prepared
[Tap item for content]	Whether you want to stop smoking completely or to cut down first, there are a couple of things you could do if you want to prepare in advance. ['Things to do' button]
	Set a date to start. Don't wait for the perfect day, because it might never come. Pick a day that you don't expect to be particularly stressful and plan something fun to keep you busy. ['Done' button]
	Let your family and friends know about your decision. Getting extra support from your loved ones can make a huge difference to help you through the tougher days. ['Done' button]
	Find ways in which you can distract yourself from cravings and withdrawal. ['Done' button]
	Think about the situations, feelings and places when you usually smoke, and plan ahead how you could avoid these in the first couple of weeks of quitting. ['Done' button]
	If you want to cut down, pay close attention to your smoking for a couple of days. Record when, where and how many cigarettes you actually smoke and identify which three cigarettes you are going to keep. You can try different combinations for a couple of days. ['Done' button]
	If you want to cut down, try to keep longer and longer times before you have a cigarette. If you smoke more than 10 cigarettes per day, start with at least two hours then increase the length of time by 30 minutes, until there is at least five hours between two cigarettes. If you normally smoke less than 10 cigarettes, start with at least 3 hours. ['Done' button]
	Learn more about nicotine replacement products that you can use to help you stop smoking completely or cut down. ['Done' button]
	Once you decide that you are going to stop smoking completely, throw away all your ashtrays, lighters and cigarettes because you won't need them any more. ['Done' button]
	['Back' button: go to Tools to quit]

'Tools to Quit' *(Appx. F-12 continued)*	
'Withdrawal symptoms' [Tap item for content]	Cope with withdrawal symptoms Your body begins to eliminate nicotine quickly when you are cutting down or going completely smokefree. As a result, you might experience withdrawal symptoms, which can be unpleasant. ['What to expect' button]
	The more you prepare for coping with withdrawal symptoms in advance, the better your chances are of getting through them without slipping back to smoking. And the fact that you are reading this right now shows that you're on the right track… [Insert 'Like/Dislike' button]
	Withdrawal symptoms are usually the worst during the first couple of days of stopping smoking, then they tend to decline until they disappear after a few weeks. You just need to hang in there for a relatively short period of time. Think about the life-long benefits that you can gain as a non-smoker. [Insert 'Like/Dislike' button]
	Research shows that pregnant women have less severe withdrawal symptoms on the first day of stopping smoking completely than non-pregnant women. [Insert 'Like/Dislike' button]
	Nicotine replacement products can help ease withdrawal symptoms and cravings either when you are cutting down or stopping smoking. [Insert 'Like/Dislike' button]
	Research shows that a bout of daily exercise can help ease nicotine withdrawal symptoms and cravings in pregnancy. It'll get you fitter too! [Insert 'Like/Dislike' button]
	Your body undergoes a lot of changes when you are expecting a baby, some of which can cause discomfort. Most of these symptoms, such as irritability, restlessness, sleep disturbances or headaches are similar to those that are caused by nicotine withdrawal. As you might experience these unpleasant symptoms anyway, don't try to make them go away by smoking! [Insert 'Like/Dislike' button]
	Explain to your loved ones that you are stopping smoking and that this might make you feel more irritable. Communicate what you need from them and let them help you. [Insert 'Like/Dislike' button]

'Tools to Quit' *(Appx. F-12 continued)*	
'Withdrawal symptoms' *(continued)*	Having difficulty concentrating is one of the withdrawal symptoms that you might experience. Many non-smoking women also experience poor concentration in pregnancy. Try to sleep enough, eat healthily and be easy on yourself- it'll go away naturally. [Insert 'Like/Dislike' button]
	You might feel sad or depressed for a few weeks. Discuss your feelings with someone and make time to go out for a walk, and do things that make you feel genuinely happy. [Insert 'Like/Dislike' button]
	Having an increased appetite is one of the withdrawal symptoms that might stay for longer. This is something that would normally occur during pregnancy anyway. To avoid excessive weight gain, try to make healthy choices: drink water, herbal tea or fruit juice rather than soft drinks. Eat more often, but eat smaller portions, and try to eat healthy snacks rather than sweets. [Insert 'Like/Dislike' button]
	The firmer you are in sticking to your non-smoking rules, the easier it will be to cope with cravings. Unfortunately, even a single puff can set you back, so do everything you possibly can to avoid it. [Insert 'Like/Dislike' button]
	['Back' button: go to Tools to quit]
'Support'	
[Add contacts]	Think about the people closest to you who you can rely on when you need support. Add their phone numbers here and call them if you feel that the urge to smoke is getting overwhelming or whenever you find it difficult to stick to your smokefree goal.
'Memos'	
[Add videos]	Help maintain your motivation to stop smoking or cut down by recording supportive video messages from your friends and family. You can also record your personal commitment to the goal you set for yourself.
'Social'	
'Tip of the day' [display a tip from the list in order and repeat the cycle]	Your social environment plays a particularly important role when you are stopping smoking or cutting down. Get tips on how you can handle social situations to avoid smoking and how you can benefit from others' support.

'Social' *(Appx. F-12 continued)*	
'Tip of the day' *(continued)*	1. Imagine that you are out with friends and you're the only one who doesn't smoke. Prepare in advance what you're going to do when they go to have a cigarette. For example you can browse the internet on your phone to kill time. [Insert 'Like/Dislike' button]
	2. Ask someone to remind you to put on a nicotine patch each day in the morning. [Insert 'Like/Dislike' button]
	3. Ask a pregnant woman who stopped during pregnancy about the positive comments she received after quitting. [Insert 'Like/Dislike' button]
	4. Come up with a plan for coping with any urges to smoke when you're out with your friends at a pub. What exactly are you going to do to avoid smoking? For example, you can decide that you will stay inside in non-smoking areas. [Insert 'Like/Dislike' button]
	5. Ask your family to help you remove all ashtrays and lighters that might remind you of smoking after you quit. [Insert 'Like/Dislike' button]
	6. Try to avoid going out with your smoker friends in the first few weeks of stopping smoking or cutting down. Social situations can remind you of your old habit and could make it difficult to stay away from smoking. [Insert 'Like/Dislike' button]
	7. If you want, you can tell your friends and family how many days you have managed to stay away from smoking so far. They'll be very proud of you. [Insert 'Like/Dislike' button]
	8. After stopping smoking, it's helpful to make your home completely smokefree and clean up everything that might remind you of the smell of cigarettes. There might be a friend or family member who you can ask to help you tidy up the house. [Insert 'Like/Dislike' button]
	9. Convince one of your smoker friends to stop smoking or cut down together, so that you can support each other every step of the way. [Insert 'Like/Dislike' button]
	10. Whether you're stopping smoking or cutting down, ask your friends not to smoke in front of you. [Insert 'Like/Dislike' button]

'Social' *(Appx. F-12 continued)*	
'Tip of the day' *(continued)*	11. Ask your female friends and family members whether they have any experiences with stopping smoking or cutting down during pregnancy. They might be able to give you useful tips and advice. [Insert 'Like/Dislike' button]
	12. Spend your quit day with your friends or family and plan to do something fun. [Insert 'Like/Dislike' button]
	13. Whether you're stopping smoking or cutting down, ask your co-workers not to invite you out to have a cigarette. [Insert 'Like/Dislike' button]
	14. Ask everyone in your family not to smoke inside the house or in the car. [Insert 'Like/Dislike' button]
	15. If anyone in your family used to buy cigarettes for you, ask them not to buy any from now on. [Insert 'Like/Dislike' button]
	16. Discuss stopping smoking together with your partner. You can give extra support to each other that no one else can, it will benefit both of you, you can save even more money, and your baby won't be exposed to second-hand smoke. [Insert 'Like/Dislike' button]
	17. Whenever you are offered a cigarette, think about the commitment you made to yourself, then reply: 'No thanks, I'm quitting.' [Insert 'Like/Dislike' button]
	18. Imagine that you bump into an old friend. You start talking and your friend lights up a cigarette. Think about how exactly you would ask your friend not to smoke in front of you. [Insert 'Like/Dislike' button]
	19. If you're feeling down after quitting, call your friend and go shopping together. [Insert 'Like/Dislike' button]
	20. Meet up with your friends in restaurants or cafes instead of bars and pubs. Avoiding situations where you used to smoke will make it easier for you to stick to your goal. [Insert 'Like/Dislike' button]
	21. Find out if there are any clubs in your area for new or pregnant mothers. You might meet someone who is also stopping smoking and will understand what you're going through. You'll be able to support each other by sharing your feelings and experiences. [Insert 'Like/Dislike' button]

'Social' *(Appx. F-12 continued)*	
'Tip of the day' *(continued)*	22. Explain to your partner, friends and family that you might be more irritable when you begin stopping smoking or cutting down. Ask them for extra support and understanding through this first stage. [Insert 'Like/Dislike' button]
	23. If you haven't done so already, tell your loved ones that you've started to use SmokeFree Baby and explain to them that you might need their support when you're stopping smoking or cutting down. [Insert 'Like/Dislike' button]
	24. Think about if there's anyone among your friends and family who could download the SmokeFree Baby app and stop smoking or cut down with you. [Insert 'Like/Dislike' button]
	25. If you have any dogs, arrange regular walking sessions with them. If you like dogs but don't have one, perhaps you can join others on their walks. Regular exercise will help you cope with withdrawals. [Insert 'Like/Dislike' button]
	26. Briefly excuse yourself from a social situation if you're finding it very difficult not to have a cigarette. For example, go to the bathroom and freshen up. [Insert 'Like/Dislike' button]
	27. Take a moment to think about how your loved ones would feel if you stopped smoking completely. [Insert 'Like/Dislike' button]
	28. Think about someone close to you. Now imagine how this person would praise you for staying away from smoking. What words would he or she use? [Insert 'Like/Dislike' button]
	29. If someone is smoking when you're around, it can cause serious health problems for you and your baby and it also increases your urges to smoke. Leave these situations as soon as you can. If you cannot leave, ask people not to smoke around you. [Insert 'Like/Dislike' button]
	30. Come up with a sentence or two that you can say if someone starts smoking in front of you or offers you a cigarette. Preparing for common situations like this in advance will help you stick to your goal. [Insert 'Like/Dislike' button]
	31. Find someone tweeting about stopping smoking during pregnancy and follow them to get extra support and advice. [Insert 'Like/Dislike' button]

'Social' *(Appx. F-12 continued)*	
'Tip of the day' *(continued)*	32. Withdrawal symptoms can be unpleasant and you might need extra support from others around you. Meet with a friend for tea and chat about how you're doing. [Insert 'Like/Dislike' button]
	33. Instead of going out somewhere, invite your friends to your house so you can avoid places where you used to smoke. This might be necessary until you build up confidence in managing your urges to smoke. [Insert 'Like/Dislike' button]
	34. Don't cave in and smoke when you're out socialising. Stick to your not a puff rule even if you're having fun. [Insert 'Like/Dislike' button]
	35. Order non-alcoholic drinks when you're out with friends. Drinking alcohol can increase the chances that you'll have a few cigarettes, so don't take this extra risk. [Insert 'Like/Dislike' button]
	36. Imagine you go for a fun night out with your friends and manage to stay away from smoking. How proud would you be of that achievement? Reward yourself with something nice the next time it actually happens. [Insert 'Like/Dislike' button]
	37. Friends are important and they can help you stay motivated to stick to your goal throughout your pregnancy. You can record your friends' supporting words in the Toolbox. [Insert 'Like/Dislike' button]
	38. Add a friend to speed dial in the Toolbox who you can call if you need extra support after quitting. [Insert 'Like/Dislike' button]
	39. There might be people who will try to distract you from stopping smoking or cutting down by claiming that smoking during pregnancy is not that bad after all. They might say that they smoked or know someone who smoked during pregnancy, and their babies were perfectly fine. Rest assured that stopping smoking is the best thing you can do for your baby, but even if you cut down, you do a lot to protect his or her health. [Insert 'Like/Dislike' button]
	40. Ask someone at your work to be your 'smokefree buddy' during a social event to help you through without lighting up. [Insert 'Like/Dislike' button]
	41. Take a moment to think about how your mum, aunt or midwife would praise you if you stopped smoking. [Insert 'Like/Dislike' button]

'Social' *(Appx. F-12 continued)*	
'Tip of the day' *(continued)*	42. Imagine how your mum would encourage you to keep going with stopping smoking even if you had a slip up. [Insert 'Like/Dislike' button]
	43. Invite your non-smoker friends when you're going out with others, so you won't be the only one who doesn't smoke. [Insert 'Like/Dislike' button]
	44. Try to stay with non-smokers when you're in a pub. That way, when your smoker friends go to have a cigarette, you won't be left alone feeling bad. [Insert 'Like/Dislike' button]
	45. Prepare for social events in advance. Think of ways to avoid passive smoking and tactics to help you stick to your smokefree goal. If you want, you can take one of the fast acting nicotine replacement products (e.g. nicotine spray) with you, just in case your cravings get worse. [Insert 'Like/Dislike' button]
	46. When you're socializing with others remind yourself that your rule is 'Not a puff, no matter what'. If you're cutting down, it's better not to have one of your three cigarettes a day during social events, because it might be more difficult not to light up another one. [Insert 'Like/Dislike' button]
	47. If you want to try nicotine replacement products to help you with your cravings, visit your GP to get further advice on how to use them effectively. [Insert 'Like/Dislike' button]
	48. Spend more time with your friends during the first days of stopping smoking. Keeping good company can help you through the days when your withdrawals are at their worst. [Insert 'Like/Dislike' button]
	49. Ask your friends and family not to offer you alcoholic drinks. Reducing your alcohol consumption is important during pregnancy and it helps you avoid slip-ups when you're stopping smoking or cutting down. [Insert 'Like/Dislike' button]
'Medicine'	
Find out which of these products can be used in pregnancy and learn more about how to use them most effectively.	

'Medicine' *(Appx. F-12 continued)*	
'Not too sure about using any of these at all?' [tap item for content]	If you are confident that you can quit smoking completely without using nicotine replacement products, that's excellent and the best possible option during pregnancy. Go for it and stick to the 'not a puff' rule from now on!
	If you feel that stopping smoking would be very difficult for you, or you want to cut down first, try nicotine replacement products - they will help you manage your cravings and withdrawal. Taking nicotine replacement products for a period of time is much less harmful than carrying on smoking, as you'll be avoiding the thousands of dangerous chemicals in tobacco smoke.
	If you decide to use nicotine replacement products, give them a real chance to support you in your quit attempt: 1. Use a combination of more than one product: go for a patch and another fast acting form, such as nicotine spray. 2. Use them as suggested by your GP or stop smoking advisor. For the best results take the right amount and use them for long enough.
'Nicotine patch' [tap item for content; display like/dislike logo once rated]	Full effect in 2-6 hours
	What's the best way to use it? Put a nicotine patch on your skin each morning (a hairless and dry area) and keep it on for the rest of the day. Depending on how long you want to leave a patch on your skin, choose between 16-hour or 24-hour patches.
	Nicotine patches can help you manage your cravings by keeping your blood nicotine levels high enough and stable during the day.
	As it takes some time for the patch to take effect, use a faster acting form (e.g. nicotine spray) as well as the patches.
	Interested in trying them out? [Insert a Like/dislike button]
'Nicotine gum' [tap item for content; display like/dislike logo once rated]	Full effect in 20-30 mins
	What's the best way to use it? First, chew the gum until the taste gets stronger - this is a sign that the nicotine is being released. Then 'park' the gum in the side of your mouth for 10 minutes while the nicotine is absorbed into your body. Then go back to chewing to release more nicotine and repeat the process.
	As it takes some time for the gum to take effect, keep a piece nearby throughout the day to avoid cravings. Also make sure you combine it with another kind of nicotine replacement product, such as nicotine patches or nicotine spray.

'Medicine' *(Appx. F-12 continued)*	
'Nicotine gum' *(continued)*	Experiment a little bit with the right chewing technique to achieve the best results. Interested in trying it out? [Insert a Like/dislike button]
'Nicotine lozenge' [tap item for content; display like/dislike logo once rated]	Full effect in 20-30 mins What's the best way to use it? Suck the lozenge just as you would with cough medicine until it dissolves in your mouth. The nicotine from the lozenge will be released and absorbed through the lining of your mouth. Use the lozenges alongside nicotine patches which deliver nicotine to your body throughout the day. Lozenges come in different flavours and strengths: ask your GP, midwife or stop smoking advisor, or browse your local pharmacy to see what types are available. Interested in trying it out? [Insert a Like/dislike button]
'Nicotine nasal spray' [tap item for content; display like/dislike logo once rated]	Full effect in 10 mins What's the best way to use it? Spray one shot into each nostril. Nicotine nasal spray is the fastest acting nicotine replacement product of all. Use it to reduce your withdrawal symptoms rapidly, so keep it in your bag to provide relief from cravings throughout the day. It is best to combine nasal spray with a slower acting form, such as nicotine patches. Don't give up using the nasal spray if you find it unpleasant at first. Smokers tend to get used to the sensations associated with it after a couple of days. Interested in trying it out? [Insert a Like/dislike button]
'Nicotine mouth spray' [tap item for content; display like/dislike logo once rated]	Full effect in 15 mins Nicotine mouth spray delivers nicotine very quickly to your body. What's the best way to use it? Spray it into your mouth and try to avoid swallowing for a few seconds to allow the nicotine to be absorbed properly. Wait for 10-15 minutes and if you are still experiencing strong cravings, spray one more shot into your mouth. It is best to combine mouth spray with a slower acting product, such as nicotine patches. Interested in trying it out? [Insert a Like/dislike button]

'Medicine' *(Appx. F-12 continued)*	
'Nicotine inhaler' [tap item for content; display like/dislike logo once rated]	Full effect in 15-20 mins What's the best way to use it? Puffing on the inhaler mimics the same hand-to-mouth action that you would do with cigarettes. Nicotine is absorbed through your mouth and throat. For the best results, use the nicotine inhaler together with nicotine patches. Interested in trying it out? [Insert a Like/dislike button]
'Microtab' [tap item for content; display like/dislike logo once rated]	Full effect in 30 mins What's the best way to use it? You don't have to chew or suck the pill, just hold it under your tongue for 30 minutes until it dissolves. Nicotine is then absorbed through the lining of your mouth. Use microtabs together with nicotine patches. To relieve cravings more rapidly, you can also use a nicotine spray. Interested in trying it out? [Insert a Like/dislike button]
'Non-nicotine medicines' [tap item for content]	Non-nicotine medicines, such as Champix or Chantix (varenicline) and Zyban (bupropion), are widely used and are effective in helping people to stop smoking. These are available in tablet form and require a prescription. Instead of delivering nicotine to your body, these medicines act on the part of your brain that is affected by nicotine and help reduce cravings and withdrawal. Always inform your GP if you are pregnant or planning to get pregnant, because these non-nicotine medicines are currently not recommended during pregnancy or while breast-feeding.

Appendix F-13: Content specification of the 'Identity' experimental intervention module in SmokeFree Baby

'Identity' module – Minimal version	
You are here because you've already made an important decision that you want to do something about your smoking. Whether you want to stop smoking completely or cut down first, take a moment to imagine yourself as a non-smoker. What would it mean for you personally and what would it mean for your baby? Building up a new identity for yourself as someone who used to smoke, but for whom smoking is not an option any more is an important part of leaving smoking behind for good.	
'Identity' module – Intensive version	
'Ex-smokers' [Insert video titles; release one video per day; insert like/dislike buttons]	Meet these pregnant ladies who used to be smokers before they successfully stopped smoking during pregnancy. They will be talking to you about their own experiences and feelings about stopping smoking to encourage you to keep going and never give up on your goal to become a non-smoker. Come back here soon, as new videos will be released on a regular basis.
'Video Diary' ['Add Video' and 'Add Image' buttons]	Use this feature to chart your pregnancy and the way you establish the new 'you' as a non-smoker. Take pictures of your growing bump and keep a video diary of your thoughts and feelings about yourself as you're becoming the kind of person you want to be: a person for whom smoking is not an option any more.
	First trimester: Week 1 – 12 [Display the person's own videos/photos here]
	Second trimester: Week 13 – 27 [Display the person's own videos/photos here]
	Third trimester: Week 28 – 40 [Display the person's own videos/photos here]
'I am…' ['Add your photo' button] [Add 'Like/Dislike' button to each item]	Imagine yourself as someone who does not smoke any more. Tap like or dislike to build the new 'you'. 'As a non-smoker, I am...' … protecting my baby … better able to do things I set my mind to … still the real 'me' … feeling good about myself … part of a group I want to belong to … special … doing something important … taking control of my life … still the same person

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'I am…' *(continued)*	… strong … giving up smoking, not my friends … less embarrassed … setting a good example … showing that I can do things if I really want to … still fun loving … part of a new group of people who do not need to smoke … setting a trend … a good role model for my child … showing how strong I can be … just as sociable as I was before … someone other people look up to … turning my life around for the better … not ashamed that I used to smoke … proud of myself … free from addiction … an inspiration to other pregnant smokers … the kind of person who sticks with things … more like my old self before I started smoking … not looked down on by other people any more … setting an important example about doing the right thing … able to help others by sharing my experiences … determined that I will never go back to smoking again … more attractive … not hanging around with smokers any more … determined that I will live a healthier life … able to resist temptations to smoke … closer to being the kind of person I really want to be … closer to people I care about … glad not to be thought of as a smoker
'Pregnancy Stages'	
Week 1 [Tap item for content]	Week 1 [Insert a visual] This is the date of your last period. You're technically not pregnant at this point, but the expected birth date of your baby is calculated from the first day of your last period. Add 9 months or 40 weeks to the first day of your last period to estimate your due date.
Week 2 [Tap item for content]	Week 2 [Insert a visual] The fertilization (conception) of your egg takes place during this week. As the egg and sperm unite, the chromosomes combine and this is when the sex of your baby is determined. This is followed by a series of cell divisions of the fertilized egg.

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Pregnancy Stages' *(continued)*	
Week 3 [Tap item for content]	Week 3 [Insert a visual] The fertilized egg has been traveling from the Fallopian tube to your uterus (womb) up until this week. In the womb, it is referred to as a 'blastocyst', which is now ready to be implanted into the wall of your uterus to begin growing.
Week 4 [Tap item for content]	Week 4 [Insert a visual] This week marks the start of the embryonic period, during which all of your baby's organs begin to develop. Head and trunk begin to appear and there are tiny buds for the arms and legs.
Week 5 [Tap item for content]	Week 5 [Insert a visual] Your baby's brain and nervous system begin to develop.
Week 6 [Tap item for content]	Week 6 [Insert a visual] Your baby's heart begins to beat. This is the first functioning organ.
Week 7 [Tap item for content]	Week 7 [Insert a visual] Your baby's liver begins to produce red blood cells. Your baby's tiny heart begins to divide into chambers.
Week 8 [Tap item for content]	Week 8 [Insert a visual] This week marks the beginning of the fetal period, during which your baby's organs and tissues begin to mature quickly and move into their final places in the body. The heart is now fully developed and divided into four chambers. Sense of smell and hearing develops as well as the baby's nervous system. Think about what this pregnancy means to you. If you want, you can share your feelings with a friend or family member.
Week 9 [Tap item for content]	Week 9 [Insert a visual] Limbs are formed by replacing cartilage with bone. Your baby's eyelids are formed, but they will stay closed for a few more weeks. Watch how your body begins to change and take photos of your growing bump.

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Pregnancy Stages' *(continued)*	
Week 10 [Tap item for content]	Week 10 [Insert a visual] Your baby now has a tiny nose, eyes, external ears and a rounded head. His or her teeth begin to form and other organs, such as the stomach, kidneys, intestines, liver and brain are in place and begin to function. Your baby's skeleton is formed and the upper and lower limbs are developed with separated fingers.
Week 11 [Tap item for content]	Week 11 [Insert a visual] The head is nearly half the size of your baby's whole body. The baby's femur, which is the bone in the thigh, is around 6mm long.
Week 12 [Tap item for content]	Week 12 [Insert a visual] Before the second trimester, most of the organs have been formed and many of them have already begun functioning. Although no bigger than your fist at this point, your baby has already developed taste buds.
Week 13 [Tap item for content]	Week 13 [Insert a visual] This week marks the beginning of the second trimester. Your baby will rapidly grow bigger and stronger in the following weeks. The organ systems continue to develop and your baby becomes more responsive to stimuli from the outside world.
Week 14 [Tap item for content]	Week 14 [Insert a visual] Your baby's heartbeats are usually strong enough to be heard by an ultrasonic device. Hearing your baby's heart beat for the first time is often a landmark moment in your life, so take this opportunity to write a letter for him or her to document how you feel about your pregnancy.
Week 15 [Tap item for content]	Week 15 [Insert a visual] Your baby's movements usually start to become strong enough by now for you to feel. Your baby can also move the arms and hands more freely now. Take a moment to visualize how your baby is floating in your womb.

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Pregnancy Stages' *(continued)*	
Week 16 [Tap item for content]	Week 16 [Insert a visual] With each week, your baby begins to notice more and more things from the environment. He or she hears the sounds from the outside world with your voice being the loudest. Also, your baby starts responding to the light that penetrates through your womb. In response to the bright light, you will notice increased kicking and moving.
Week 17 [Tap item for content]	Week 17 [Insert a visual] Unique fingerprints are developed and the nails begin to form at the tips of your baby's fingers and toes. Sweat glands begin to develop.
Week 18 [Tap item for content]	Week 18 [Insert a visual] Your baby now has eyelashes and eyebrows, and he or she can even make facial expressions (although the eyes are still closed) that you can capture with an ultrasound. Ask your practitioner to print out the ultrasound scan for you to take home.
Week 19 [Tap item for content]	Week 19 [Insert a visual] If you haven't already, you might start noticing that your baby is busy kicking and moving inside your womb. Experiment with different first names to see how they sound with your baby's surname.
Week 20 [Tap item for content]	Week 20 [Insert a visual] The sex of the baby usually becomes clear on the ultrasound around this week, so if you want to, you can find out whether you are expecting a boy or a girl. It's a good time to tell your baby how much you love him or her already.
Week 21 [Tap item for content]	Week 21 [Insert a visual] Your baby grows a fine hair that covers its whole body. Your baby's skin has a very wrinkly appearance due to the low level of body fat at this stage. Have a baby shower to celebrate your pregnancy with your friends and family.

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Pregnancy Stages' *(continued)*	
Week 22 [Tap item for content]	Week 22 [Insert a visual] Up until now, your baby has spent most of his or her time awake, but now you might begin to notice that there are patterns of active and quiet times during the day. Your movements can wake up your baby, and similarly, your baby's increased movements at night will possibly wake you up! Tell your baby that you are happy to know that he or she is busy in there but you need to get some good sleep! Responding to your baby's behaviour is getting more and more important as he or she is growing.
Week 23 [Tap item for content]	Week 23 [Insert a visual] The body and the face of your baby start to resemble a newborn baby. If you have one, put the ultrasound picture on your fridge and spend some time thinking about what your baby will look like.
Week 24 [Tap item for content]	Week 24 [Insert a visual] You might find that your baby is kicking strongly, and you might even notice when he or she has hiccups. The ears are also formed by now. When you feel kicking respond by gently touching your bump and talking to your baby.
Week 25 [Tap item for content]	Week 25 [Insert a visual] Your baby can distinguish between familiar and unfamiliar voices. Ask your partner to speak to your baby regularly. Your baby's bones begin to harden, except for the bones in the scull. Your baby's immune system is continuing to develop.
Week 26 [Tap item for content]	Week 26 [Insert a visual] Your baby starts making breathing movements, but the respiratory system is not matured enough at this stage and there is no air in the lungs. Have you thought about the kind of parent you want to become? Take a moment to imagine yourself as a mum. If you have a child already, is there anything you would like to do differently this time?

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Pregnancy Stages' *(continued)*	
Week 27 [Tap item for content]	Week 27 [Insert a visual] Your baby is sensitive to a variety of stimuli from your environment. Development of the senses will be completed during the beginning of the third trimester. Your baby will respond to light, sound and also to touch by kicking and increased movements in your womb. Ask your friends and family whether they had similar experiences during their pregnancies?
Week 28 [Tap item for content]	Week 28 [Insert a visual] This week marks the beginning of the third trimester. Your baby will gain a lot of weight, but he or she will grow less in terms of length. For the rest of your pregnancy your baby's brain, central nervous system and respiratory system will continue to develop. Use this app to document the progress of your pregnancy.
Week 29 [Tap item for content]	Week 29 [Insert a visual] Your baby's eyes and teeth are formed and taste buds are fully developed. The surface of your baby's brain begins to form grooves and folds. The muscles are building up too. If you haven't done so already, explore the options of where you want to give birth and consider joining a pregnancy class.
Week 30 [Tap item for content]	Week 30 [Insert a visual] Your baby can now open his or her eyes. Sight, hearing, touch and taste are developed by now. By speaking to your baby regularly you can provide important stimuli for further brain development. If you are expecting a baby boy, his testes are descending to the scrotum around this week. Imagine what it's going to be like to raise your little boy or girl.
Week 31 [Tap item for content]	Week 31 [Insert a visual] The fine hair that covers your baby in the womb, starts to disappear. Antibodies are also building up in your baby at around this stage of your pregnancy.

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Pregnancy Stages' *(continued)*	
Week 32 [Tap item for content]	Week 32 [Insert a visual] Your baby now has a daily pattern of sleeping and waking. Your baby is still very tiny, so he or she continues to gain weight in the following weeks. Think about the ways you are going to try to calm your crying baby.
Week 33 [Tap item for content]	Week 33 [Insert a visual] You might start to notice a change in your baby's movements - mainly because he or she is getting bigger - and there's less room in your womb. Try to identify your baby's feet by touching your bump.
Week 34 [Tap item for content]	Week 34 [Insert a visual] Most of your baby's organs finish developing around this week. The lungs still need to mature so they can breathe when your baby is outside the womb. If you haven't done so already, start listening to a specific piece of music: your baby will be able to recognize it after birth!
Week 35 [Tap item for content]	Week 35 [Insert a visual] Your baby continues to gain more weight and develop fat layers beneath the skin. The brain and nervous system continue to develop rapidly. These are very important milestones for making sure the body stays at the right temperature after birth.
Week 36 [Tap item for content]	Week 36 [Insert a visual] Your baby's eyes are blue, but the colour might change within the first few weeks after birth. Your baby has a more rounded body shape now, and he or she continues to prepare for birth by going further down into your pelvis. How about you? Are you ready for the birth of your little one?

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Pregnancy Stages' *(continued)*	
Week 37 [Tap item for content]	Week 37 [Insert a visual] Congratulations! This week marks the milestone of having a full-term pregnancy. Normally, your baby's lungs are matured enough by now to breath air outside your womb. Your baby will gain weight and continue to develop until birth. Make an entry in your Video Diary to document this week.
Week 38 [Tap item for content]	Week 38 [Insert a visual] Your baby is pretty big now so he or she doesn't have much room to move inside your womb. Most of the organs will be ready for birth soon, but the lungs, brain and immune system continue to grow during the last weeks. The baby's wrinkled skin becomes smoother around this week.
Week 39 [Tap item for content]	Week 39 [Insert a visual] Your baby's organs are developed and he or she is now ready for life outside your womb. Talk to your baby and say how much you're looking forward to welcoming him or her into the world.
Week 40 [Tap item for content]	Week 40 [Insert a visual] By the time you read this, you might have already given birth to your beautiful baby. If not, it'll be happening very soon, as he or she is ready to meet you any time now.
'Tip of the Day'	
1. Tip of the Day: Who are you?	Imagine that you want to introduce yourself as clearly as possible. Finish the sentence: 'I am…' What are the most important characteristics that define you? Now think about what it would mean to you personally if you became a non-smoker? Was this helpful? [Insert Like/Dislike button]
2. Tip of the Day: I've always been a smoker	You might feel that smoking has always been a part of who you are, and stopping smoking would mean that you lose something of yourself. Think about what you can gain by making not smoking an essential part of your identity. Make a list of all the things about yourself that won't change even if you become a non-smoker. Was this helpful? [Insert Like/Dislike button]

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Tip of the Day' *(continued)*	
3. Tip of the Day: Not just a break	Research shows that people who do not establish a strong non-smoker identity are more vulnerable to start smoking again. Remind yourself that you're not taking a break from smoking just for the sake of pregnancy, but you're becoming a non-smoker for good! Was this helpful? [Insert Like/Dislike button]
4. Tip of the Day: Your child's perspective	Take a moment to imagine your child's life if you were a smoker. How would he or she feel about it? And how would that make you feel? Now imagine your child's life if you were a non-smoker. How could your child benefit from you being a non-smoker for the rest of your life? How do you picture your life together? Was this helpful? [Insert Like/Dislike button]
5. Tip of the Day: Think simple	Changing your identity might sound a bit overwhelming, but actually it's quite simple. First, you need to make a firm decision that you want to be a non-smoker. Then, do everything you can to stick to your smokefree goal. It's important that you appreciate even the smallest victories you achieve along the way. You will slowly gain confidence and rebuild your identity as a person who doesn't smoke any more. Was this helpful? [Insert Like/Dislike button]
6. Tip of the Day: Chances of quitting	People who have positive feelings about being a smoker are less likely to try to make a quit attempt. One of the most important rules about stopping smoking is simple: *keep trying*. You might succeed at first, you might not - but if you don't try you will never succeed. Was this helpful? [Insert Like/Dislike button]
7. Tip of the Day: Your new identity	You have already put a lot of effort into leaving your old smoking habit behind you. Now you need to stay strong for the rest of your pregnancy and beyond. To avoid future temptations, remind yourself that you want to become the kind of person who does not smoke, no matter what. Was this helpful? [Insert Like/Dislike button]

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Tip of the Day' *(continued)*	
8. Tip of the Day: Identities	Our identity is all the thoughts, images and feelings we have about ourselves. You can have different identities simultaneously, including those relating to your personal and professional roles, psychological and personal characteristics, the groups you belong to, activities you engage in and anything that you use to define who you are. What does smoking mean to you personally? And what else could you do instead of smoking? Was this helpful? [Insert Like/Dislike button]
9. Tip of the Day: Past, present and future	Our identities help us understand who we were in the past, who we are in the present, and also who we want to be in the future. Think about the kind of person you want to become. What would you need to do to achieve this? If you think about smoking, what thoughts and images do you have about yourself? How do you feel about it? Was this helpful? [Insert Like/Dislike button]
10. Tip of the Day: Being part of the group	Important aspects of our identity can relate to what groups we are a part of, or would like to belong to. Think about the groups that are important to you. Are there ways these groups can help you to stop smoking? Do some of the groups potentially make stopping smoking more difficult for you? How might you overcome those difficulties? Was this helpful? [Insert Like/Dislike button]
11. Tip of the Day: Identity and behaviour	The thoughts you have about yourself can generate strong 'wants' and 'needs' to become a non-smoker. Establishing a new identity in which there's absolutely no place for smoking can help you exercise self-control and stick to your smokefree goal. Was this helpful? [Insert Like/Dislike button]
12. Tip of the Day: Dreams about smoking	Imagine waking up in the morning after having a dream that you smoked a cigarette. Now imagine how you would feel about yourself if you really did break your commitment to stopping? Was this helpful? [Insert Like/Dislike button]
13. Tip of the Day: Images and feelings	Think about all of the things about yourself that you are most proud of. Now, think about the things that you are least proud of. What thoughts do you have about yourself in relation to smoking? Establishing a strong motivation to become a non-smoker can help you achieve your smokefree goal in the long term. Was this helpful? [Insert Like/Dislike button]

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Tip of the Day' *(continued)*	
14. Tip of the Day: Once a smoker, always a smoker?	One of the great things about every single one of us is that we have the potential to change our identities as we go through life. Think about any aspect of your identity that used to be important to you but isn't any more. It doesn't matter how long you've been a smoker, you can establish a non-smoker identity and wave goodbye to cigarettes. Was this helpful? [Insert Like/Dislike button]
15. Tip of the Day: Becoming a non-smoker	Take a moment to imagine yourself as a non-smoker. How would it make you feel if you were a non-smoker? What would you look like? In what ways would your life be different? Was this helpful? [Insert Like/Dislike button]
16. Tip of the Day: Smoker identity	How would you describe yourself in relation to smoking? Finish the sentence: 'I am…' How would you like to describe yourself in the future? Finish the sentence: 'I want to become…' Was this helpful? [Insert Like/Dislike button]
17. Tip of the Day: Identity matters	We are all motivated to behave in ways that maintain our identities, regardless of whether the behaviour is good or bad for us, or for the people around us. If taking on a 'non-smoker' identity is important to you, this will help you stick to your goal of stopping smoking. Was this helpful? [Insert Like/Dislike button]
18. Tip of the Day: I'm not a smoker, but…	'I'm not a smoker, but I do have a cigarette once in a while.' Watch out if you happen to have similar thoughts, because these loosen the boundaries around not smoking, and you can be more vulnerable to lighting up again. Say instead 'I'm not a smoker and I won't have a single puff, no matter what.' Was this helpful? [Insert Like/Dislike button]
19. Tip of the Day: Not a 'real smoker'	Sometimes smokers say that they do not consider themselves 'real smokers', because they never buy cigarettes for themselves, they don't smoke that many cigarettes per week or they never smoke alone. It's important to recognize when you start making explanations to yourself or others why your smoking behaviour is not that bad after all. Remind yourself that you want to become a person for whom smoking is not an option at all. Was this helpful? [Insert Like/Dislike button]

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Tip of the Day' *(continued)*	
20. Tip of the Day: Take your time	It might take some time to fully establish your new non-smoker identity. Don't worry if you still think about yourself as a smoker even after quitting. Focus on your goal and keep the image of yourself as a non-smoker in your mind. Was this helpful? [Insert Like/Dislike button]
21. Tip of the Day: Just a social smoker	'I only have one or two cigarettes every now and then when I'm out with my friends.' 'I only smoke when I have a drink.' 'I never smoke alone.' Do any of these sound familiar? If you want to leave smoking behind for good, being a social smoker is not an option either. The problem with these kind of personal rules is that they make smoking occasionally acceptable and you will be more likely to slip back to becoming a regular smoker again. Was this helpful? [Insert Like/Dislike button]
22. Tip of the Day: If you stay a smoker	Imagine what your life would be like if you carried on smoking after your baby was born. What would your life be like in 5 or 10 years time? How would you feel about that? Then think about how you and your baby's life would change for the better if you become a non-smoker for good. Was this helpful? [Insert Like/Dislike button]
23. Tip of the Day: Not smoking	Whether you think about it consciously or not, your identity can influence your behaviour. If you make 'not smoking' a deeply entrenched part of your identity you have a good chance of giving up smoking for good. Was this helpful? [Insert Like/Dislike button]
24. Tip of the Day: Role models	Role models can be important in establishing your new non-smoker identity. Is there anyone who you consider an inspiration for yourself? Someone who possesses the qualities that you would like to have? Remember: you too can be a role model for others, especially for your child. Was this helpful? [Insert Like/Dislike button]
25. Tip of the Day: Make your own crowd	You might worry that if you stop smoking, you won't belong to the same social groups as you did when you were a smoker. In fact, you can potentially influence more people around you than you might think. Instead of losing a group, you can make a new one by inspiring your smoker friends and family members to quit as well. Was this helpful? [Insert Like/Dislike button]

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Tip of the Day' *(continued)*	
26. Tip of the Day: This is who I want to be	It's a good time to look back and see what you've achieved so far, and also to think about the future. What things are you happy with about establishing a non-smoker identity? And what are the things you need to do better to become the person you want to be? Was this helpful? [Insert Like/Dislike button]
27. Tip of the Day: No one can force you	To change your identity, you need to have the desire to become a non-smoker. It has to be personally important to you. Only then will your motivation be strong enough to fight any temptations to have a cigarette and cope with any withdrawal symptoms. Was this helpful? [Insert Like/Dislike button]
28. Tip of the Day: Positive smoker identity	If you were to ask 100 adult smokers in England if they liked being a smoker, how many of them do you think would say yes? You might be surprised to find out that research shows that only 18% of adult smokers report that they like being a smoker. Was this helpful? [Insert Like/Dislike button]
29. Tip of the Day: Stigma	Some people say that they don't care what other people think about them. But the truth is that we all care to some extent, and let's be honest, smoking is becoming increasingly stigmatized. Have you ever experienced negative comments from other people because you smoke? How do you imagine people would look at you if you became a non-smoker? Was this helpful? [Insert Like/Dislike button]
30. Tip of the Day: Rules	Personal rules are the kind of things that you would normally do or not do. Think about yourself and list as many rules as you can to finish the sentence: 'I am the kind of person who would… ('do' or 'do not do' something)' Try to formulate rules around not smoking. For example you might say 'I am the kind of person who would not smoke even if I had a drink', or 'I am the kind of person who would not go back to smoking even if I was feeling down.' Reminding yourself of these personal rules will help you avoid smoking in tempting situations. Was this helpful? [Insert Like/Dislike button]

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Tip of the Day' *(continued)*	
31. Tip of the Day: Conflict	We all have different aspects of our identity and many of these tend to support each other. For example, if you are an adventurous person you might also have a job working outdoors. However, when there's a clash between our different identities, it can cause tension within ourselves or with others around us. For example, being a mum and also working in a demanding professional job. Identify any aspects of your identity that are conflicting with you being a smoker and think about how would it change your life if you stopped smoking? Was this helpful? [Insert Like/Dislike button]
32. Tip of the Day: Take it easy	Being pregnant and stopping smoking can use up a lot of mental energy. Make sure that you are getting enough sleep, relaxing and generally taking it easy on yourself. You will need your mental strength to stick to your goal whenever a tempting situation to light up arises. Was this helpful? [Insert Like/Dislike button]
33. Tip of the Day: Things I would never do	Think about the kind of things that you would never do in your life, because you find them unacceptable. For example, you might say that you would never hit a child, or you would never offer him or her a cigarette etc. Now imagine that smoking is one of those things you would never do – smoking is unacceptable and doesn't fit in with the kind of person you want to be. Was this helpful? [Insert Like/Dislike button]
34. Tip of the Day: Quit for yourself	Stopping smoking during pregnancy is critically important for the sake of your baby, but it's also important for you to feel that you are stopping for yourself too. Not only will your baby be healthier, but you will live a longer happier life as well. Was this helpful? [Insert Like/Dislike button]
35. Tip of the Day: Carry on	Do everything you can to stick to your 'not a puff' rule and work on changing the way you think about yourself in relation to smoking. Building up a new identity as someone who used to smoke, but for whom smoking is not an option any more is an important part of leaving smoking behind for good. Was this helpful? [Insert Like/Dislike button]

'Identity' module – Intensive version *(Appx. F-13 continued)*	
'Tip of the Day' *(continued)*	
36. Tip of the Day: Just one cigarette	There might be situations in which the temptation to have a cigarette is very strong and you might be thinking that it wouldn't cause any harm. Unfortunately, even a single puff can set you back, so it's important that you remind yourself of your personal rule that smoking is not an option for you at all. Is it worth giving up all the hard work you've done up until now for that one puff? Imagine how you would feel in the morning. Was this helpful? [Insert Like/Dislike button]
37. Tip of the Day: Non-smoker for good	Unfortunately, a huge proportion of pregnant women who successfully stopped smoking during pregnancy will go back to smoking once the baby is born. Remind yourself that you are not stopping simply because you are pregnant and take a moment to think about how you imagined your life as a non-smoker in the first place. Then you can go to 'I am...' in SmokeFree Baby to refresh your non-smoker profile. Was this helpful? [Insert Like/Dislike button]
38. Tip of the Day: Be a non-smoker mum	Right after birth, your baby begins to learn from your behaviour by constantly observing it. As he or she gets older, you become an important role model. Establishing an identity now, in which there's no place for smoking, is the best way for you to become a mum who provides a good non-smoker role model for your child. Was this helpful? [Insert Like/Dislike button]
39. Tip of the Day: Slip ups	Imagine how you would feel about yourself if you had a cigarette after stopping smoking. You might be disappointed, but remember that you've learnt a lot already about yourself and stopping smoking, and you can use these lessons to help you as you carry on towards becoming a non-smoker for good. Was this helpful? [Insert Like/Dislike button]
40. Tip of the Day: Future goals	Think about your personal and professional goals and future aspirations. Is there anything that would be easier to achieve as a non-smoker? Was this helpful? [Insert Like/Dislike button]

Appendix F-14: Content specification of the 'Stress relief' experimental intervention module in SmokeFree Baby

'Stress Relief' module – Minimal version
Pregnancy can be a joyful period of your life, but sometimes it can also be very stressful. You might feel that the physical and emotional changes that you are going through and the nicotine withdrawal symptoms are overwhelming, and you would rather have a cigarette. Overcoming your cravings when you feel stressed is crucial to giving up smoking for good. Bear in mind that smoking doesn't reduce stress, it simply relieves your withdrawal symptoms. Relaxation techniques, breathing exercise or low intensity physical activity can actually help you relieve your stress and deal with cravings in one go.
'Stress Relief' module – Intensive version
'Deep breathing'
[The ball will grow for 4 sec – Insert text 'Breathe in', then stay still for 3 sec – Insert text 'Hold your breath;' then shrink for 4 sec – Insert text 'Breathe out'; run only one session at a time and insert – 'Tap ball to start and repeat' button; Insert timer in the ball]. Lower your stress by controlling your breathing! When you are stressed you begin to breath faster and shallower, your heart begins to beat faster and your muscles are tensed. Feeling stressed is an important risk factor of relapse during smoking cessation. Instead of having a cigarette try this deep breathing exercise that helps you lower your heart rate and relieve the stress in your whole body. It's easy to learn and you can do it anywhere at any time. For this to work, it's important that you concentrate fully on your breathing: Breath in slowly through your nose, then hold your breath, then exhale through your mouth. Tap the ball to start and repeat until you feel calmed down and more relaxed.
'Stress Plan'

1. Stress	Stress is a normal and inevitable part of life. It is your body's response to being put under too much emotional or mental pressure. Stress occurs when you are exposed to any kind of threat, or when something upsets the balance of your life. Was this helpful? [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
2. Stressors	Stressors are things that can cause stress. These can be anything from having relationship issues, worrying about deadlines, having financial difficulties or working under a lot of pressure. Your thoughts about any particular situation will determine whether you perceive it as stressful, and your thoughts will also influence the ways in which you respond to it. Was this helpful? [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
3. Identify your stressors	In order to develop effective strategies to cope with stress, first you need to be aware of your own stressors. What kinds of things and situations would generally make you feel stressed? Don't forget that stressful situations can increase the risk of having a relapse, so play a close attention to these situations in the next couple of days and make a list for yourself as a reminder. Was this helpful? [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
4. Control your stressors	One way of coping with stress is by controlling the stressors that cause it. Think about the situations when you feel stressed and when you would normally have a cigarette to deal with it. What are the things in these situations that you might have control over? Focus only on those aspects and think about how you will try to control them next time. Was this helpful? [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
5. Pregnancy and stress	It isn't only negative events that cause stress, positive events such as expecting a baby can also make you feel overwhelmed. Your body is changing, your emotions are changing, and your living conditions might be also changing. There is a lot to take on, but you can learn how to manage stress during pregnancy effectively. The important thing for you now is to find ways to deal with the stress in your life without smoking. Was this helpful? [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
6. Identify your methods for dealing with stress	Think about your methods of dealing with stress. What do you usually do? Some of the strategies you might use can be good for your health, if you're doing some exercise or relaxation for example. Other strategies, such as smoking or drinking alcohol just appear to reduce your stress and these can seriously damage your health. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
7. Engage in activities that you enjoy	Think about simple things that you can do for free to give yourself a bit of a treat. For example, you can relax in the bathtub or in a warm shower. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
8. Response to stress	When you're stressed, your heart rate and blood pressure increase, your muscles become tightened and your breath quickens. You might also become angry, anxious, irritable or depressed. You need to learn how to manage your stress, otherwise it could seriously damage your chances of quitting. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
9. Pay attention to yourself	Pay attention to the changes in your body when you start to feel stressed. Then use methods to reduce your stress immediately to calm yourself before you get overwhelmed by the situation. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
10. Your personal beliefs	Take a moment to think about the role smoking plays in your life, particularly when you are stressed. Do you usually have a cigarette when you're under a lot of pressure? As long as you think that smoking reduces your stress and you use this strategy to help you cope with stressful situations, it will make it very difficult to stick to your goal. Learn alternative strategies to deal with stress. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
11. Write a stress diary	Write a stress diary and make notes about any stressful situations that happened to you during the day. Concentrate on the Who? What? When? Where? How? questions. When and where did it happen? Who was involved? What did you think and feel? How did the situation end? Instead of having a cigarette, what else could you have done to relieve your stress? [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
12. Scream	When stress becomes overwhelming and all you feel is tension and anxiety, scream into a pillow as loud as you can and just let all these negative things go! [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
13. Smoking and stress reduction	Despite smokers' common perception that smoking reduces stress, it just relieves the stress caused by smoking itself. What happens is this: smokers experience withdrawal symptoms of anxiety and irritability after a few hours of not smoking. Then when they have a cigarette it simply relieves the withdrawal symptoms smoking created in the first place. But the truth is that smoking doesn't help reduce stress. In fact non-smokers report far lower levels of stress than smokers. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
14. Do a muscle relaxation exercise (lower body)	You can do this exercise in any position, but you might want to do it sitting or lying down. This exercise involves tensing each group of muscles in your lower body for 6-10 seconds, then relaxing them completely for 12-20 seconds, as follows. Breathe normally. Tense your toes and feet. Then relax. Tense your lower legs by pointing your toes towards your face first, then pointing your toes towards the floor. Then relax. Finally tense your thighs. Then relax. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
15. A common misconception	Be aware that there are a number of myths around stopping smoking during pregnancy, and unfortunately these can put some women off trying to quit. One of these misconceptions is that the stress caused by quitting is more harmful for the baby than continuing smoking. The truth is that stopping smoking during pregnancy is the most important thing mums can do to protect their babies. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
16. Change your perspective	Sometimes it can be very useful to change the way we view potentially stressful situations and look at them from a more positive perspective. Imagine the following situation: You're in a hurry and your bus gets into a traffic jam. You have absolutely no control over the traffic, but you can change how you react to the situation. Instead of feeling stressed, try to find a positive aspect of the situation: use this time to check your emails or listen to music. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
17. Stopping smoking and stress reduction	The latest scientific evidence shows that stopping smoking is associated with better mental health. People who stop smoking have lower levels of stress, anxiety and depression than those who continue smoking. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
18. Is it really important?	Every time you find yourself in a stressful situation and you begin to have negative feelings, ask yourself: Is the situation important? If the situation is not important, is it worth feeling bad about it? Try to avoid any unnecessary stress in your life and focus on those things that really matter to you. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
19. Stress reduction	Stress is not necessarily bad, but excessive or unnecessary stress should be avoided. The main aim of any stress management technique is not to eliminate stress from your life, but to give you resources that you can use to deal with stress in healthy and effective ways. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
20. Can you change it?	Think about whether there's anything that you can do to change the stressful situation. If there is, concentrate on how you can change it for the better as soon as possible instead of wasting your mental energy worrying about it. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
21. Ways to reduce stress	There are many things you can do to reduce stress, for example: breathing exercises, relaxation techniques, meditation, physical activity and changing the way of you think. Try out as many stress management strategies as you can and you'll soon find out what works for you. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
22. Say 'No'	You have the right to say 'No' to the demands other people make on you in order to protect yourself from stress overload. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
23. Go easy on yourself	You probably already have a lot on your plate. You're expecting the baby, things might be changing on a daily basis around you and now you're stopping smoking (which alone is tough enough) so don't be too hard on yourself. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
24. Exercise regularly	Doing some light exercise regularly not only reduces your stress, but it gives you more energy and makes you feel happier. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
25. Get support	Get as much support as you possibly can from friends, family and stop smoking experts. Different people might be able to help you in different ways, and the fact that you're not alone could make a huge difference to your wellbeing. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
26. Set achievable goals	Make sure that you break down your bigger goals into achievable smaller goals. You don't have to worry about everything all at once. Accomplishing these smaller goals one-by-one will give you confidence and a feeling of satisfaction. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
27. Be less critical	Try to be more generous and less critical of yourself and of others around you. It's certainly not an easy period of your life and you need to keep as much mental energy free as you can to help you stop smoking. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
28. Focus on the bigger picture	You made a commitment to yourself to stop smoking completely or cut down on your cigarettes, and you need to keep this firmly in your mind from now on. Things might get difficult every now and then, but don't focus on everything at the same time. Keep your goal in mind and don't allow stressful situations to distract you. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
29. Listen to music	Research shows that listening to music can reduce anxiety. This is a very simple way to ease your stress, and you can do it almost anywhere. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
30. Join a zumba class	There are many zumba classes being advertised specifically for pregnant women. If you don't fancy zumba, you could go swimming or simply just exercise at home. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
31. Write about stressful situations	If there's a particular situation that caused a great deal of stress for you in the past, instead of constantly thinking about it, write down everything you have in your mind. What was the problem? How did you feel? How are you feeling now? The point is to put everything in writing and then let the situation and all the negative feelings go. So once you finish, tear the paper up and throw it away. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
32. Avoid the person who makes you feel stressed	If possible, try to avoid people who repeatedly make you feel stressed. You won't necessarily be able to change others people's behaviour, but you can change the way you behave. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
33. Share responsibilities	If you feel that your workload is getting overwhelming, it might be a good idea to share your responsibilities with others to reduce your stress. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
34. Make your own quiet time	Allocate specific times during each day for you to unwind and clear your mind. Sit down with a cup of tea and just relax. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
35. Pay attention to your environment	Instead of thinking about your worries, focus on your environment, the colours, smells, noises around you. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
36. Don't procrastinate	You can delay dealing with your tasks, but the stress they cause will stay with you until you accomplish them. So stop procrastinating and limit your unnecessary stress. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
37. Eat healthily	Having a healthy balanced diet can help you deal with stress. Eat small amounts at a time, but make sure you eat regularly (at least 5-7 times a day). [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
38. Cut down on your stimulants	Try to reduce your caffeine intake and avoid foods that are high in sugar. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
39. Snack on healthy food	When you're feeling stressed, you can try snacking on a handful of unsalted, untoasted cashews, or some raw vegetables to reduce your tension. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
40. Share your feelings	Share your feelings and thoughts with someone close to you. Talking about the things that you're stressed about can help relieve your tension and anxiety. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
41. Seek another perspective	Whether or not they are involved, your friends or family members might be able to give you another perspective on a stressful situation. Maybe they can help you change the situation, or help you accept that you need to change. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
42. Create a budget for yourself	Financial difficulties can be very stressful. You cannot necessarily change your situation completely, but there are small things that you can do to make improvements. For example, you can create a budget for yourself for each month and stick to it no matter what. You can then clearly see that the money you save by stopping smoking can be spent on more important things, such as your bills. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
43. Go outside	Spend some time outside. Go for a walk in your local park. If you cannot go outside, open the window and take some deep breathes from there. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
44. Watch a comedy	If you're at home, you can watch a new comedy to get rid of your stress. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
45. Get a stress ball	Get a stress ball and keep it with you throughout the day. When you're feeling stressed, just squeeze it in one hand until the tension begins to drain away from your body. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
46. An imaginary place	When you are in a stressful situation, think about where you would rather be. What does that place look like? What can you hear? What can you smell? What would you do there? [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
47. Have a cup of herbal tea	There are different herbal teas that you can choose from to relax. Make yourself a nice cup of camomile or lemongrass tea. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
48. Write a letter	Write a letter to the person who made you feel stressed. Write down all your thoughts and feelings, and the things that you would say if you had the chance. Once you finish writing, tear the letter up and throw it away. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
49. Leave the situation	Sometimes the only way to reduce your stress is by leaving the stressful situation. Obviously try not to get trapped in stressful situations, but if you cannot change them for the better, take the decision to walk away. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
50. List 3 good things a day	Make a list of 3 good things that happened to you during the day. These can be very small things, like a nice word from a stranger, or bigger things, like managing to stick to your goal on SmokeFree Baby. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
51. Think simple	A great deal of stress can come from overthinking situations. Thoughts like 'What will other people think?', 'What did she or he mean by that?' etc. can make your life complicated, so sometimes it's better to save your mental energy and let things go. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
52. Take a photo of something nice	Take a photo of something nice around you. It can be a flower, a painting, a child, a dog, a house, anything that makes you feel happy when you're looking at it. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
53. Change the way you react	For effective stress management, you need to take charge of your thoughts, feelings and reactions. Challenges will always be there in your life, but you can choose how you respond to them and you can do it without smoking! [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
54. Avoid stressful situations	Avoid stressful situations if possible. If not, limit their effects on you by reducing the tension in your body and making time for relaxation. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
55. Get enough sleep	Make sure that you have enough rest every day and you get plenty of sleep at night. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
56. Get a hug or give a hug	If you're in need of a bit of tender loving care ask your loved ones to give you a hug. Giving a hug can also help relieve your stress and make you feel happier. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
57. Know your limits	Know your limits both in terms of personal and professional responsibilities. Taking on more than you can handle is often a source of immense stress. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
58. Enjoy your food	Eat a small portion of your favourite food, not to satisfy your hunger but just to enjoy the taste. Take the time to relish each bite and pay attention to the sensations in your mouth. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
59. Draw something	Express your thoughts and feelings in a drawing. Even if you don't think of yourself as an artist, you can use this type of activity to relieve your anxiety and clear your mind. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
60. Reward yourself	Do something with one goal in mind: to make yourself happy. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
61. Get a massage	It might cost you some money, but a good strategy to relieve stress and reduce the tension in your body is to get a massage. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
62. Go for a walking meditation	Go for a walk outside. Walk at a normal pace and pay full attention to the sensations in your body while walking: how your arms and legs move, how your feet lift and move forward and how your breath. If you begin to realize that you're being distracted by your environment, try to bring your attention back to yourself and let the tension fall away from your body, as you are walking. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
63. Communicate your needs	Don't assume that people will always figure out what you would like them to do. You need to find ways to clearly and openly communicate your needs with your loved ones without getting into a fight! [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
64. Breathing exercise	There are a lot of different breathing exercises that you can try to help you reduce your stress. Learn more about the different techniques online. We provide you with one possible method in this app. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
65. Meditation	Many different meditation techniques exist that can help you deal with stress. Go online and learn more about the different forms, such as Zen meditation or mindfulness. Try some of these out to see if they work for you. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
66. Make a to-do list	Write down all the things that you need to do during the week and break them down into daily tasks. Even if you have a lot on your plate, focus on the tasks one by one and don't worry about the next day's jobs in advance. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
67. Prioritize your tasks	If you have an awful lot to do at the same time, try to prioritize your tasks. What are the things that you must accomplish first and what can wait for a while? Work from the top of your list and concentrate on one thing at a time. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
68. Dance and sing	Dancing, like other forms of physical activity, can help you relieve your stress. It's a fun thing to do, it's free and you won't need any special equipment except a music player. Feel free to sing your favourite songs as you're dancing around! [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
69. Do a muscle relaxation exercise (torso)	You can do this relaxation in any position, but it's best to sit or lie down somewhere. This exercise involves tensing each group of muscles in your body for 6-10 seconds, then relaxing them completely for 12-20 seconds, as follows. Breathe normally. First, tense your stomach by sucking it in a little bit. Then relax. Next, tense your back. Then relax. And finally tense your chest. Then relax. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
70. Don't overgeneralize	When you're feeling stressed, it's easy to generalize your negative feelings and reactions to other things as well. This may induce thoughts like: 'Everything around here is crazy' and 'My whole day is ruined'. Pay attention when you make (or think) generalized statements, and once you recognize them, try to replace your negative thinking with more realistic thoughts. For example, instead of thinking 'Everything around here is crazy' think about particular situations that caused the stress i.e. 'Getting to work was crazy this morning'. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
71. Remember that stress cannot control you	Remind yourself every time you feel stressed that it cannot control you. You have control over the stress by changing the way you think and feel about it. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
72. Imagine yourself being relaxed	When a situation becomes overwhelming, imagine how it would feel to be completely relaxed. What kinds of sensations would you have in your body? How would that feel? [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
73. Combined breathing and relaxation exercise	This is a 1-minute stress reduction exercise. Sit comfortably. Now inhale deeply. Exhale slowly and relax your body. Inhale deeply and clench your fists; exhale slowly and relax. Inhale and tense your feet; exhale slowly and relax. Inhale and shrug your shoulders; exhale slowly and relax. Inhale and turn your head to the left; exhale slowly and relax. Inhale and turn your head to the right; exhale slowly and relax. Finally, inhale deeply once again; exhale slowly and relax your whole body. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
74. Count your breaths	This exercise requires you to pay full attention to your breathing. Take a deep breath. Exhale. Now start counting your breaths in your mind: inhale deeply, '1', exhale slowly. Inhale deeply, '2', exhale slowly. Inhale deeply, '3', exhale slowly. Don't let any other thoughts distract your attention. You just focus on counting and breathing. Keep going until you feel your tension starts to ease. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
75. Do yoga	There are many different yoga styles to choose from, some of which are specifically recommended for pregnant women. Check with your practitioner if you can do yoga and then find out if there are any classes in your area where you can practise with a trained instructor. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
76. Learn from previous situations	Effective stress management is something that we all learn as we go along with our lives. Think about the ways you deal with stress in different situations. What was helpful? What did you do well? What could you have done better? Taking an honest look at yourself can help you improve your stress management skills. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

'Stress Relief' module – Intensive version *(Appx. F-14 continued)*	
'Stress Plan' *(continued)*	
77. Do a muscle relaxation exercise (neck and head)	You can do this relaxation in any position, but it's best to sit or lie down somewhere. This exercise involves tensing each group of muscles in your body for 6-10 seconds, then relaxing them completely for 12-20 seconds, as follows. Breath normally. First, tense your neck by touching your chin to your chest. Then relax. Now tense your neck by leaning your head back. Then relax. Move upwards to your facial muscles: Smile as widely as you can. Then relax. Now press your lips together tightly. Then relax. Finally, close your eyes tightly. Then relax. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
78. Make time for your hobbies	Make sure that you allocate time each week for your hobbies. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
79. Know your strategies	A strategy that works very well in one situation might not be useful in a different one. That's why it's important to have a toolbox of different strategies ready to be used when needed. To improve your stress management skills, make sure that you spend some time practicing your strategies at a time when you're not feeling stressed. [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]
80. Do a muscle relaxation exercise (upper limbs)	You can do this relaxation in any position, but it's best to sit or lie down somewhere. This exercise involves tensing each group of muscles in your body for 6-10 seconds, then relaxing them completely for 12-20 seconds, as follows. Breathe normally. First, tense the muscles in your shoulders by shrugging them. Then relax. Then tense your arms. Then relax. Finally tense your hands. Then relax [Insert Like/Dislike button] [Insert 'Add tip to Stress Plan' button]

Appendix F-15: Content specification of the 'Health effects' experimental intervention module in SmokeFree Baby

'Health Effects' module – Minimal version		
By stopping smoking completely during pregnancy you do a lot for your baby's health. You reduce the risk of having pregnancy complications and your baby is less likely to be born too early with a low birth weight. As a young child, he or she will be less likely to get respiratory infections. When your child gets older, he or she will be less likely to develop behaviour and learning problems.		
'Health Effects' module – Intensive version		
'Health Quiz'		
How much do you really know about smoking? Take the quiz and find out! [Tap option to submit; give feedback: green tick on screen if correct; red cross on screen if not] [Insert 'Start Quiz' button]		
1. Which of these substances in tobacco smoke prevent red blood cells from carrying enough oxygen to your baby?	A. Nicotine B. Carbon monoxide C. Tar D. All of above	B: Carbon monoxide is a highly poisonous gas that stops red blood cells carrying enough oxygen to your baby.
2. How many chemicals are there in tobacco smoke that are known to cause cancer?	A. At least 1000 B. At least 250 C. At least 69 D. At least 27	C: There are thousands of chemicals in tobacco smoke, of which 69 are known to cause cancer.
3. Smoking during pregnancy can cause which of the following problems?	A. Preterm birth B. Type 1 diabetes C. Both A and B D. None of these	A: Smoking during pregnancy increases the risk of having a preterm birth. Preterm babies are born before 37 weeks of pregnancy.
4. The nicotine in tobacco smoke causes which of the following?	A. Addiction B. Adverse consequences for the baby's brain development C. Premature birth D. All of above	D: Nicotine causes addiction and it has negative health consequences for the baby.
5. Life long smokers die approximately how many years earlier than non-smokers?	A. 25 B. 10 C. 5 D. 2	B: Life-long smokers die approximately 10 years earlier than non-smokers.

'Health Effects' module – Intensive version *(Appx. F-15 continued)*		
'Health Quiz' *(continued)*		
6. Which of the following health benefits occur immediately after quitting smoking?	A. Decreased risk of heart attack B. Decreased risk of lung cancer C. Nicotine is completely eliminated from the body D. All of above	A: As substances in tobacco smoke stop damaging your blood vessels and heart, you immediately have a lower risk of having a heart attack or stroke than if you continue smoking.
7. When is it safe to allow someone to smoke next to you?	A. If you're travelling only for short distances in the car with the windows opened B. If you're not expecting a baby C. If the person smokes low tar cigarettes D. It's never safe	D: Inhaling other people's tobacco smoke is never safe and it damages your and your baby's health.
8. Smoking causes lung cancer in which group of people?	A. Male smokers B. Female smokers C. Anyone who inhales other people's tobacco smoke D. All of above	D: Smoking can cause lung cancer both in active smokers, and in those who inhale other people's tobacco smoke.
9. From a group of 10 smokers, about how many of them will die due to a smoking-related disease unless they stop?	A. All of them B. Half of them C. 1-2 of them D. No way to tell	B: Half of all long term smokers, who do not quit will probably die as a result of their smoking.
10. Passive smoking causes which of the following health problems in adults?	A. Diabetes B. Stroke C. COPD (Chronic Obstructive Pulmonary Disease) D. Both A and C	B: Smoking can lead to strokes in non-smokers who inhale other people's tobacco smoke.
11. Passive smoking causes which of the following health problems in children?	A. Middle ear disease B. Lower respiratory illness C. Both A and B D. None of these	C: Children who inhale other people's tobacco smoke have a greater risk of developing middle ear disease and respiratory illnesses.
12. How long does someone need to inhale other people's smoke before it becomes harmful?	A. Less than 5 minutes B. 15-30 minutes C. 1-2 hours D. Many months	A: Passive smoking is never safe: even a short period of exposure is harmful.

'Health Effects' module – Intensive version *(Appx. F-15 continued)*		
'Health Quiz' *(continued)*		
13. How soon after quitting is nicotine eliminated from the body?	A. Nicotine is never eliminated completely from the body	C: There will be no nicotine in your body 48 hours after quitting smoking.
	B. In 2 hours	
	C. In 2 days	
	D. In 2 weeks	
14. Having a baby born with low birth weight is more likely if…	A. The mum was smoking before pregnancy, but stopped completely	B: Inhaling other people's tobacco smoke increases the risk of having a baby born with a low birth weight in non-smoker mums.
	B. The mum stopped smoking during pregnancy, but she was exposed to other people's smoking	
	C. None of these	
	D. All of above	
15. Which of these diseases develop almost exclusively in smokers?	A. Buerger's disease	A: Buerger's disease affects the veins and arteries in the limbs. The blood vessels become inflamed and blocked with clots, which can lead to amputation.
	B. Tourette's disease	
	C. Alzheimer's disease	
	D. None of the above	
16. Which of the following is true?	A. Smokers die younger but they have the same quality of life as non-smokers	C: Life-long smokers die younger than non-smokers. They also have fewer years of being healthy without any chronic conditions.
	B. Male smokers die younger than male non-smokers, but there's no difference between female smokers and female non-smokers	
	C. Both male and female life-long smokers die younger than non-smokers	
	D. None of the above	
17. What percentage of all lung cancer is caused by smoking?	A. 100%	B: About 90% of lung cancer is caused by smoking.
	B. About 90%	
	C. About 60%	
	D. No way to tell	

'Health Effects' module – Intensive version *(Appx. F-15 continued)*		
'Health Quiz' *(continued)*		
18. Which of the following is true after stopping smoking?	A. Ex-smokers feel more miserable than before they quit	C: Research shows that people are happier and less stressed after stopping smoking.
	B. Ex-smokers feel more stressed and anxious than before they quit	
	C. Ex-smokers are happier and less stressed than before they quit	
	D. Both A and B	
19. Which of the following effects does the exposure to tobacco smoke in the womb have on babies' lungs?	A. Tobacco smoke exposure before birth doesn't have a direct effect on the babies' lung functions.	D: Exposure to tobacco smoke during pregnancy damages your baby's lungs, which can lead to more frequent respiratory illnesses during childhood.
	B. Active or passive smoking during pregnancy strengthens the babies' lungs, because they get used to the tobacco smoke.	
	C. They will recover quicker from respiratory illnesses after birth.	
	D. None of the above	
20. What is the link between smoking and asthma?	A. Smoking increases the risk for severe asthma attacks in anyone	B: Research shows that smoking increases the risk for severe asthma attacks in people who already have asthma
	B. Smoking increases the risk for severe asthma attacks only in those who already have asthma	
	C. Smoking worsens asthma only in very young children	
	D. Scientific studies have failed to prove the link between asthma and smoking	

'Health Effects' module – Intensive version *(Appx. F-15 continued)*		
'Health Quiz' *(continued)*		
21. Among other poisonous substances, tobacco smoke contains ammonia, arsenic, cyanide and formaldehyde. Which one is NOT in the second-hand smoke?	A. All of them are in second-hand smoke B. Cyanide is not in second-hand smoke C. Ammonia is not in second-hand smoke D. None of these are in second-hand smoke	A: Inhaling other people's tobacco smoke is very dangerous as it contains thousands of dangerous chemicals.
22. How many cigarettes per week are absolutely safe to smoke during pregnancy?	A. Up to 5 B. Up to 10 C. Up to 20 D. There's no such a thing as a safe amount of smoking	D: There is no absolutely safe amount of cigarettes. If you cannot stop smoking completely, try to reduce your smoking to a minimum.
23. Which of the following effects of smoking are likely to develop in young people?	A. Low bone density B. Eye diseases C. Shortness of breath and coughing D. The negative effects of smoking only develop in old age.	C: As smoking damages the lungs, shortness of breath and coughing can develop at any age.
24. The more the mother is exposed to second-hand smoking the greater her risk of having...	A. A pregnancy that grows outside the womb B. A miscarriage C. A stillbirth D. All of above	D: Even after quitting smoking, exposure to other people's tobacco smoke can cause serious health problems for you and your baby.
25. How soon after quitting does your heart rate go back to normal?	A. Within minutes B. Within hours C. Within days D. Within months	A: One of the immediate health benefits of stopping smoking is that your heart rate returns to normal, and your risk of a heart attack decreases.
26. The more the mother smokes during pregnancy…	A. The lower her baby's birth weight will be B. The stronger her baby's immune system will be C. Both A and B D. None of the above	A: The best thing to do is to stop smoking completely, but you can decrease the risk of having a low birth weight if you reduce the amount you smoke.

'Health Effects' module – Intensive version *(Appx. F-15 continued)*		
'Health Quiz' *(continued)*		
27. Which of the following is linked to both active and passive smoking by the mum during pregnancy?	A. Increased blood pressure in the mum B. Low birth weight for the baby C. Lower back pain in the mum D. All of above	B: If you smoke cigarettes during pregnancy or you are exposed to other people's smoke, your baby has a greater risk of being born with a low birth weight.
28. On average, how many years sooner do smokers start to develop chronic diseases compared with non-smokers?	A. There's no difference between smokers and non-smokers. B. Smokers begin to develop chronic conditions 1-2 years earlier C. Smokers begin to develop chronic conditions 5-7 years earlier D. Smokers begin to develop chronic conditions 10-11 years earlier	D: Life-long smokers not only live shorter by 10 years, but they live the last 10-11 years with a chronic condition.
29. Being overweight as a child is one of the health consequences of…	A. Smoking prior to pregnancy B. Smoking during pregnancy C. Stopping smoking during pregnancy D. None of the above	B: There is some evidence that suggests smoking during pregnancy increases the risk of your child becoming overweight.
30. On average, female smokers start the menopause how many years earlier than non-smokers?	A. Up to 2 years earlier B. Up to 7 years earlier C. Up to 10 years earlier D. Smoking has no effect on menopause.	A: Long-term female smokers start the menopause earlier than non-smokers due to the effects of smoking.
31. Which of the following pregnancy complications that require a caesarean section is linked with smoking during pregnancy?	A. Severe abdominal pain B. Urinary tract infections C. Low-lying placenta D. None of the above	C: Low-lying placenta (called placenta previa) is when the placenta is in the wrong position and blocks the baby's exit through the vagina.

'Health Effects' module – Intensive version *(Appx. F-15 continued)*		
'Health Quiz' *(continued)*		
32. When do your lungs start to recover after quitting smoking at a young age?	A. Within minutes B. Within days C. Within months D. The lungs will never fully recover	B: Within 72 hours of stopping smoking your lungs begin to heal themselves.
33. To avoid the increased risks of smoking-related diseases completely you should…	A. Offset your smoking with a healthy diet and regular physical activity B. Stop smoking completely C. Avoid active and passive smoking completely D. The increased risks of smoking-related diseases cannot be avoided.	C: The best thing to do is to stop smoking and avoid other people's smoke as well.
34. Smokers in their 40s have as many facial wrinkles as...	A. Non-smokers in their 40s B. Non-smokers in their 50s C. Non-smokers in their 60s D. Non-smokers in their 70s	C: Smoking damages your skin and speeds up the aging process.
35. When a mum stops smoking during pregnancy…	A. The baby feels a lot of stress due to withdrawal symptoms B. The baby begins to feel the benefits of stopping smoking almost immediately C. The baby begins to feel the benefits after birth D. There is no way to tell how it effects the baby	B: After quitting smoking, the abnormally high heart rate of your baby immediately begins to return to normal.
36. By stopping smoking you can lower the risks of developing which of the following diseases?	A. Cervical cancer B. Type 1 diabetes C. Both A and B D. None of the above	A: Smoking increases your risk of developing cervical cancer

'Health Effects' module – Intensive version *(Appx. F-15 continued)*		
'Health Quiz' *(continued)*		
37. Women who stop smoking are…	A. More likely to breastfeed for a shorter period of time B. More likely to have better milk production when breastfeeding C. Both A and B D. None of these	B: Breastfeeding prevents your baby from a variety of diseases and women who stop smoking tend to have better milk production and breastfeed for longer.
38. Which of the following dangerous chemicals in tobacco smoke get through the placenta?	A. Nicotine B. Carbon monoxide C. Both A and B D. The main role of the placenta is to protect the baby from any potential harm, so none of these chemicals can reach the baby	C: Nicotine, carbon monoxide and many other dangerous chemicals from tobacco smoke get through the placenta and damage your baby's health.
39. Smoking throughout pregnancy can cause reduced lung functions in the baby for how long?	A. Up to the first couple of days after birth B. Up to the first couple of months after birth C. Up to the first couple of years after birth D. Reduced lung function even in late childhood	D: Smoking during pregnancy has long-term effects on your baby's health that can emerge throughout childhood and beyond.
40. Which of the following occur immediately after quitting smoking?	A. Heart rate and blood pressure decrease B. Blood pressure decreases C. Heart rate decreases D. None of the above	C: Your abnormally high heart rate will return to normal right after you stop smoking.
[After the last question]	Well done for completing all questions in the SmokeFree Baby Health Quiz! You answered [insert final score] out of the 10 questions correctly. [Insert 'Take a new quiz' button: go to first question] [Insert 'Exit' button: go to module home]	

'Health Effects' module – Intensive version
(Appx. F-15 continued)

'My Body'

Soon you will be welcoming your baby into the world. As much as you need to look after yourself during pregnancy, you also need to think long term. You can avoid or significantly reduce the risks of a number of diseases by stopping smoking. Tap dots for more information.	
[Dot – head; tap for content]	Stroke: disturbed or blocked blood supply to the brain that leads to permanent disability or immediate death Blindness: complete loss of sight Cataract: leads to cloudy vision Age-related macular degeneration: leads to loss of vision in the centre of the eyes
[Dot – mouth; tap for content]	Periodontitis: damaged soft tissue and bone around the teeth that leads to tooth loss Oropharyngeal cancer: affects the base of the tongue, the soft palate, the tonsils and the back wall of the throat
[Dot – neck; tap for content]	Laryngeal cancer: affects the part of the throat where the voice is produced Oesophageal cancer: affects the part of the body which links the throat with the stomach
[Dot – thorax (1); tap for content]	Pneumonia: chronic inflammation of the lung tissue Cancer of the lungs, trachea and bronchus COPD (chronic obstructive pulmonary disease): this includes different chronic lung diseases Tuberculosis: bacterial infection of the lungs
[Dot – thorax (2); tap for content]	Aortic aneurysm: rupture of the largest blood vessel in the body that can lead to immediate death Coronary heart disease: disturbed or blocked blood supply in the coronary arteries of the heart that leads to angina or heart attack
[Dot – upper abdomen; tap for content]	Cancer of the liver Cancer of the pancreas Type 2 diabetes: if untreated this leads to heart disease, strokes, impaired vision, amputation, miscarriage and stillbirth Cancer of the stomach
[Dot – lower abdomen (1); tap for content]	Cancer of the kidneys and ureter Cancer of the bladder Cancer of the cervix Bowel cancer: affects the colon and the large intestine

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'My Body' *(continued)*	
[Dot – lower abdomen (2); tap for content]	Ectopic pregnancy: the embryo implants itself outside the womb leading to the loss of the fetus and potentially to the death of the mother Miscarriage: loss of the baby in the first 24 weeks of pregnancy Stillbirth: loss of the baby after 24 weeks of pregnancy Placenta previa: abnormal position of the placenta that leads to severe bleeding Premature rupture of the membrane: leads to premature delivery and the death or long term illness of the baby
[Dot – lower limb; tap for content]	Acute myeloid leukemia: cancer of the white blood cells Rheumatoid arthritis: autoimmune disease that leads to the chronic inflammation in the joints Peripheral vascular disease: decreased blood supply in the limbs that can lead to amputation Osteoporosis: low bone density
'My Baby'	
By stopping smoking, you do more for your child than you might ever imagine. Tap dots to find out more. [Display the visuals with dots on them]	
[Dot – Birth]	At birth Your baby has a better chance of a healthy start in life by: - getting the necessary nutrition and oxygen to develop healthily; - growing and developing long enough and well enough in your womb to be ready for the outside world; - having a normal heart rate while in the womb Make sure that after you stop smoking, you're not exposed to other people's smoke either.
[Dot – Childhood]	During childhood Your child has a better chance of avoiding frequent illnesses by having lower risks of: - impaired lung function; - middle ear disease; - lower respiratory illnesses, such as bronchitis, bronchiolitis and pneumonia. Make sure that your child is not exposed to other people's tobacco smoke either.

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'My Baby' *(continued)*	
[Dot – School-age]	During school-age years Your child has a better chance of achieving well in school by having lower risks of: - developing behaviour problems, such as hyperactivity, attention deficit disorder and increased aggression; - developing learning problems, such as having difficulty in understanding arithmetic, oral and spelling tasks. Make sure that your child is not exposed to other people's tobacco smoke either.
[Dot – Teenage and young adult]	During teenage years and young adulthood Your child has a better chance of not taking up smoking. Try to make sure that he or she is not exposed to other family members' smoking either.
[Dot – Adult]	Adulthood Your child is likely to remain a life-long non-smoker if he or she has not taking up smoking before the age of 26. Passive smoking matters: Being exposed to passive smoke for more than 10 years as a child can increase your daughter's risks of having pregnancy complications.
'Tip of the Day'	
1. Health facts: A baby with low birth weight	A baby born weighing less than 2500 g (5.5 pounds), is considered to have a low birth weight. A baby born weighing less than 1500 g (3.3 pounds) is considered to have a very low birth weight. Because they are so tiny and weak these babies have a greater risk of dying as a newborn and also developing long-term health problems. By stopping smoking, you can reduce the risk of your baby having a low birth weight. Was this health fact helpful? [Insert Like/Dislike button]
2. Health facts: Benefits of quitting	It is generally true that the earlier you stop the better, but even if you quit smoking at a later stage of your pregnancy, you can still increase your chances of having a baby born at full-term with a normal birth weight. Was this health fact helpful? [Insert Like/Dislike button]
3. Health facts: Mental health	Smoking can increase the risk of developing depression in adults. But research shows that stopping smoking improves mental health. Was this health fact helpful? [Insert Like/Dislike button]

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'Tip of the Day' *(continued)*	
4. Health facts: Effects on the baby	If you keep smoking your child might not be able to take part properly in sports activities due to breathing problems. It's better to quit smoking now rather than regret it later when the damage is done. Was this health fact helpful? [Insert Like/Dislike button]
5. Health facts: Effects on you	The word ectopic means 'in the wrong place'. In ectopic pregnancies the fetus starts to develop outside the mother's womb, usually in one of the fallopian tubes. As the pregnancy grows it causes pain and bleeding and if not treated, it can be fatal for the mum. Unfortunately, the pregnancy won't survive. By stopping smoking, you can avoid the increased risk of having an ectopic pregnancy. Was this health fact helpful? [Insert Like/Dislike button]
6. Health facts: Unrealistic optimism	Sometimes people are unrealistically optimistic and believe that bad things only happen to other people and not themselves. A classic example is when smokers believe that although smoking kills half of its life-long users, they will probably be in the half that doesn't die. This optimism isn't based on the facts or the smoker's actual chances of developing a smoking-related disease. Was this health fact helpful? [Insert Like/Dislike button]
7. Health facts: Passive smoking	It's important to remember that when someone is smoking next to you, you and your baby are exposed to passive smoking. This also very dangerous and you need to avoid it at all times. Was this health fact helpful? [Insert Like/Dislike button]
8. Health facts: SIDS	SIDS refers to 'Sudden infant death syndrome', also known as 'cot death', which is the sudden and unexplained death of babies, usually in the first 6 months. You can reduce your baby's risk of SIDS by stopping smoking. Was this health fact helpful? [Insert Like/Dislike button]
9. Health facts: The placenta	When you're pregnant, your baby gets its oxygen and nutrients from you via the placenta and umbilical cord. Smoking during pregnancy is especially harmful because many of the dangerous chemicals from tobacco smoke will pass through the placenta and eventually reach your baby. Was this health fact helpful? [Insert Like/Dislike button]

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'Tip of the Day' *(continued)*	
10. Health facts: Why smoking is so harmful	There are thousands of chemicals that you inhale every time you have a cigarette. Many of these are called 'carcinogens' which means they can cause cancer in your body. Was this health fact helpful? [Insert Like/Dislike button]
11. Health facts: A baby with low birth weight	There is a common misconception that having a baby with a low birth weight is no bad thing because the delivery is easier. Make no mistake: it is a serious health condition. Babies born to women who smoked during pregnancy tend to be smaller and usually require intensive care in the hospital after birth. They also have a higher risk of infections and cot death. Was this health fact helpful? [Insert Like/Dislike button]
12. Health facts: Avoiding a preterm birth	For about 9 months, the best possible place for your baby to grow and develop is in your womb. By stopping smoking, you can increase the chance that your baby will be born after all his or her organs are fully developed. Was this health fact helpful? [Insert Like/Dislike button]
13. Health facts: Benefits of quitting	Smoking ages the skin drastically, and it begins to do so even in your 20s and 30s. Current smokers have more facial wrinkles than non-smokers or ex-smokers, so it's better to stop smoking as soon as possible! Was this health fact helpful? [Insert Like/Dislike button]
14. Health facts: Effects on delivery	Developing a low-lying placenta is one of the health complications during pregnancy that is linked with smoking. It is when the placenta covers the cervix (neck of the womb) partly or completely, which sometimes makes it necessary to perform a caesarean section at delivery. Was this health fact helpful? [Insert Like/Dislike button]
15. Health facts: Effects on you	Smoking worsens Crohn's disease, which is a long-term condition that causes inflammation of the lining of the digestive system. Was this health fact helpful? [Insert Like/Dislike button]
16. Health facts: Mental health	Smoking can increase the risk of developing panic disorders in adults, but stopping smoking improves mental health. Was this health fact helpful? [Insert Like/Dislike button]
17. Health facts: While in the womb	After you stop smoking, make sure that you avoid passive smoking as well, because it also increases the risk of your baby being born with low birth weight. Was this health fact helpful? [Insert Like/Dislike button]

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'Tip of the Day' *(continued)*	
18. Health facts: Why smoking is so harmful	When you're inhaling the smoke from a cigarette, poisonous chemicals get into your bloodstream through the lining of your mouth and lungs and eventually reach every organ in your body. Smoking is extremely harmful, but you can avoid its damaging effects by quitting. If you can't stop smoking completely, reduce the number of cigarettes you smoke to a minimum. Was this health fact helpful? [Insert Like/Dislike button]
19. Health facts: Passive smoking	After you stop smoking, you still need to make sure that you avoid passive smoking, which can also cause cancer in non-smokers. To eliminate the effects of smoking completely from your life, avoid both active and passive smoking. Was this health fact helpful? [Insert Like/Dislike button]
20. Health facts: A preterm baby	A preterm baby is one that is born before 37 weeks of pregnancy. A very preterm baby is born before 28 weeks. One of the main concerns with these babies is that their organs didn't have enough time to fully mature before birth, which can lead to long-term health problems and potentially to their death as a newborn. By stopping smoking, you can reduce the risk of having your baby born preterm. Was this health fact helpful? [Insert Like/Dislike button]
21. Health facts: Benefits of quitting	Stopping smoking is linked with reduced depression, anxiety and stress. Was this health fact helpful? [Insert Like/Dislike button]
22. Health facts: Effects on the baby	Children who are exposed to smoking during pregnancy have a greater risk of being born with birth defects that leave them with a cleft lip and palate. Was this health fact helpful? [Insert Like/Dislike button]
23. Health facts: Effects on you	Smoking during pregnancy increases the risk of developing a condition which stops the baby exiting through the vagina. This happens because the placenta is covering the cervix (neck of the womb). In this instance, a caesarean section is usually performed. Was this health fact helpful? [Insert Like/Dislike button]
24. Health facts: While in the womb	Smoking during pregnancy increases the risk of the baby not growing normally in the womb. Was this health fact helpful? [Insert Like/Dislike button]

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'Tip of the Day' *(continued)*	
25. Health facts: Passive smoking	Has your throat ever felt 'scratchy' when inhaling tobacco smoke? Your baby would experience something very similar after birth if he or she inhaled other people's smoke . In both cases this sensation is a sign that smoking is damaging the lining of the lungs. Was this health fact helpful? [Insert Like/Dislike button]
26. Health facts: A preterm baby	Preterm babies are born before 37 weeks of pregnancy. They require intensive care after birth, so they need to stay in the hospital for weeks or months. One of the most important things that you can do to lower the risk of a preterm birth is to stop smoking completely, or reduce the number of cigarettes you smoke to a minimum. Was this health fact helpful? [Insert Like/Dislike button]
27. Health facts: Benefits of quitting	One of the immediate benefits of quitting is that your increased heart rate will go back to normal. Was this health fact helpful? [Insert Like/Dislike button]
28. Health facts: Effects on the baby	When you inhale tobacco smoke, substances from tobacco smoke travel through the placenta and increase your baby's heart rate. This means that his or her heart has to beat a lot faster than normal. After you stop it will go back to normal immediately. Was this health fact helpful? [Insert Like/Dislike button]
29. Health facts: Effects on you	You can avoid the increased risk of developing serious dental diseases that can cause teeth loss by stopping smoking. Was this health fact helpful? [Insert Like/Dislike button]
30. Health facts: Passive smoking	Being exposed to tobacco smoke after birth will irritate your baby's airways and can cause various respiratory illnesses and sudden infant death syndrome. Was this health fact helpful? [Insert Like/Dislike button]
31. Health facts: While in the womb	Chemicals from tobacco smoke in the mother's bloodstream reduce the amount of oxygen and nutrition that can reach the baby. As a result, the baby won't be developing properly. Was this health fact helpful? [Insert Like/Dislike button]
32. Health facts: Benefits of quitting	Your risk of a heart attack goes down within minutes of stopping smoking. Was this health fact helpful? [Insert Like/Dislike button]

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'Tip of the Day' *(continued)*	
33. Health facts: Effects on the baby	Some women mistakenly believe that smoking makes the baby stronger, as his or her lungs have already got used to the tobacco smoke before birth. The truth is that babies born to mothers who smoked during pregnancy are more likely to have lung problems. Was this health fact helpful? [Insert Like/Dislike button]
34. Health facts: Benefits of quitting	If you quit smoking at an early stage of your pregnancy, your risk of having a preterm birth (before 37 weeks of pregnancy) will be similar to non-smokers. Was this health fact helpful? [Insert Like/Dislike button]
35. Health facts: Effects on you	In terms of your physical appearance, smoking discolours your teeth and nails. Was this health fact helpful? [Insert Like/Dislike button]
36. Health facts: While in the womb	Carbon monoxide is one of the poisonous substances that get into your baby's bloodstream when you smoke. It then reduces the oxygen that reaches your baby, which makes his or her tiny heart beat faster. Was this health fact helpful? [Insert Like/Dislike button]
37. Health facts: Benefits of quitting	Have you stayed away from smoking completely for a day? The increased level of carbon monoxide in your body will drop within 24 hours of quitting. Was this health fact helpful? [Insert Like/Dislike button]
38. Health facts: Effects on the baby	Often the effects of smoking on your baby cannot be observed directly until the damage is done. Don't let this mislead you: just because you can't see what's happening doesn't mean that smoking isn't harming your baby. Was this health fact helpful? [Insert Like/Dislike button]
39. Health facts: Effects on you	Smoking damages your skin. It causes a grey pallor and wrinkles all over your face, particularly around your lips and eyes. Was this health fact helpful? [Insert Like/Dislike button]
40. Health facts: While in the womb	The small particles from tobacco smoke can damage the placenta and this can reduce its ability to protect and feed your baby in the womb. Was this health fact helpful? [Insert Like/Dislike button]
41. Health facts: Benefits of quitting	After a year of quitting smoking, your risk of a heart attack will be halved. Was this health fact helpful? [Insert Like/Dislike button]
42. Health facts: Effects on the baby	Smoking during pregnancy can increase the risks of your child becoming a smoker when he or she grows up. Was this health fact helpful? [Insert Like/Dislike button]

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'Tip of the Day' *(continued)*	
43. Health facts: Effects on you	If you have asthma, smoking will worsen your asthma symptoms and increase the frequency of severe asthma attacks. Was this health fact helpful? [Insert Like/Dislike button]
44. Health facts: Benefits of quitting	How far are you at the moment with quitting? After 48 hours of stopping smoking, your lungs and airways begin to clean. Was this health fact helpful? [Insert Like/Dislike button]
45. Health facts: Effects on the baby	Smoking during pregnancy can increase the risks of your child developing anti-social behaviour and attention-deficit hyperactivity disorder (ADHD) in young adulthood. Was this health fact helpful? [Insert Like/Dislike button]
46. Health facts: Effects on you	You might have heard about people who never smoked in their lives and still developed lung cancer. It can certainly happen; however, 9 out of 10 deaths from lung cancer are due to smoking. Was this health fact helpful? [Insert Like/Dislike button]
47. Health facts: Benefits of quitting	The extra carbon monoxide from smoking is eliminated from your body within the first 24 hours of quitting. This will also improve your baby's oxygen supply in the womb. Was this health fact helpful? [Insert Like/Dislike button]
48. Health facts: Effects on the baby	Smoking during pregnancy can increase the risks that your child will have behaviour and learning problems throughout childhood. Was this health fact helpful? [Insert Like/Dislike button]
49. Health facts: Effects on you	Smoking increases the chance that you'll get a stroke - a health condition with devastating consequences like irreversible brain damage or immediate death. Was this health fact helpful? [Insert Like/Dislike button]
50. Health facts: Benefits of quitting	Within 48 hours of stopping smoking, nicotine will be cleared out of your body. Was this health fact helpful? [Insert Like/Dislike button]
51. Health facts: Effects on the baby	Smoking during pregnancy can increase the risk that your child will be overweight throughout childhood. Was this health fact helpful? [Insert Like/Dislike button]
52. Health facts: Effects on you	A stroke can occur due to the damaging effects of chemicals in tobacco smoke on your blood circulation: they narrow your arteries, make your blood thicker and increase your heart rate and blood pressure. Was this health fact helpful? [Insert Like/Dislike button]

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'Tip of the Day' *(continued)*	
53. Health facts: Benefits of quitting	Within a few hours of quitting the circulation in your hands and feet will improve. Was this health fact helpful? [Insert Like/Dislike button]
54. Health facts: Effects on the baby	Losing a child is a devastating experience and unfortunately sometimes these events can't be prevented. However, there are things that you can do to minimise your risk such as stopping smoking. Was this health fact helpful? [Insert Like/Dislike button]
55. Health facts: Effects on you	Smoking increases your pulse. The normal heart rate ranges from 60-100 beats per minute (though it can be a bit higher in pregnancy). After you quit smoking, your pulse will return to normal. Was this health fact helpful? [Insert Like/Dislike button]
56. Health facts: Benefits of quitting	Within a few days of stopping smoking, your lungs begin to heal as the substances from tobacco smoke start to clear away. Was this health fact helpful? [Insert Like/Dislike button]
57. Health facts: Benefits of quitting	Shortly after quitting smoking, your sense of smell will improve. Was this health fact helpful? [Insert Like/Dislike button]
58. Health facts: Effects on the baby	Delivering a baby with a low birth weight is the main pregnancy complication known to be linked with both active and passive smoking. The less you smoke, the greater your chances of having a normal birth are. Was this health fact helpful? [Insert Like/Dislike button]
59. Health facts: Effects on you	Switching to light, ultra light or low tar cigarettes will not reduce the risks of smoking either on you or your baby. These cigarettes are just as harmful as regular cigarettes. Was this health fact helpful? [Insert Like/Dislike button]
60. Health facts: Benefits of quitting	If you want to do something to maintain your natural beauty and youthful appearance, stopping smoking is a good first step! Was this health fact helpful? [Insert Like/Dislike button]
61. Health facts: Effects on the baby	Babies born to mothers who smoked during pregnancy have smaller organs on average. They tend to be born with a smaller head, brain and lungs. Was this health fact helpful? [Insert Like/Dislike button]
62. Health facts: Effects on you	Some of the smoking-related diseases are likely to develop at an older age, such as eye diseases that lead to permanent visual impairment or complete blindness. Was this health fact helpful? [Insert Like/Dislike button]

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'Tip of the Day' *(continued)*	
63. Health facts: Benefits of quitting	After a few weeks of quitting, most ex-smokers feel happier and less anxious. Was this health fact helpful? [Insert Like/Dislike button]
64. Health facts: Effects on the baby	Did you know that children who are exposed to smoking at home are more likely to take up smoking later in life? Was this health fact helpful? [Insert Like/Dislike button]
65. Health facts: Effects on you	Smoking accounts for about 90% of all COPD cases, which is a collection of chronic respiratory conditions, including chronic bronchitis and emphysema. Was this health fact helpful? [Insert Like/Dislike button]
66. Health facts: Benefits of quitting	By stopping smoking during pregnancy and keeping your baby away from passive smoking after birth, you can reduce the risks of your child missing school due to regular illnesses. Was this health fact helpful? [Insert Like/Dislike button]
67. Health facts: Effects on the baby	Middle ear disease is a very painful condition, which occurs more frequently in children who were exposed to tobacco smoke in the womb. Was this health fact helpful? [Insert Like/Dislike button]
68. Health facts: Effects on you	Smoking is linked with an increased risk of developing chronic lower back pain. Was this health fact helpful? [Insert Like/Dislike button]
69. Health facts: Benefits of quitting	Stopping smoking gives you the best chance of living a healthier, longer life in which you'll be able to see your child grow up. Was this health fact helpful? [Insert Like/Dislike button]
70. Health facts: Effects on the baby	By stopping smoking you can prevent your baby from the long-term negative health effects of tobacco smoke. For example, your baby will have a lower risk of developing middle ear disease during early childhood. Was this health fact helpful? [Insert Like/Dislike button]
71. Health facts: Effects on you	The latest scientific evidence shows that smoking can cause Type-2 diabetes. Was this health fact helpful? [Insert Like/Dislike button]
72. Health facts: Benefits of quitting	After stopping smoking, if you still experience shortness of breath during your pregnancy, this is probably because your baby is growing and putting extra pressure on your diaphragm. Was this health fact helpful? [Insert Like/Dislike button]

'Health Effects' module – Intensive version *(Appx. F-15 continued)*	
'Tip of the Day' *(continued)*	
73. Health facts: Effects on the baby	Even if they are born healthy, babies who were exposed to tobacco smoke in the womb are likely to be ill more often. This can mean they need to be taken to the hospital more frequently within the first year of their life and spend more time on medicine. Was this health fact helpful? [Insert Like/Dislike button]
74. Health facts: Effects on you	In general, only 9% of people who have lung cancer survive for five or more years. You can avoid the increased risk of having lung cancer by stopping smoking now. Was this health fact helpful? [Insert Like/Dislike button]
75. Health facts: Benefits of quitting	Your baby won't be able to smell tobacco smoke on your hair and clothes when you're holding him or her. Was this health fact helpful? [Insert Like/Dislike button]
76. Health facts: Effects on the baby	Women who smoke during pregnancy are more likely to have baby with a cleft lip and palate, which normally requires a series of reconstructive surgeries throughout childhood. Was this health fact helpful? [Insert Like/Dislike button]
77. Health facts: Effects on you	The more you are exposed to passive smoking, the greater your risks of having a miscarriage, stillbirth and ectopic pregnancy (when a fertilised egg implants itself outside the womb). Was this health fact helpful? [Insert Like/Dislike button]
78. Health facts: Benefits of quitting	Luckily, you are now expecting a baby, but smoking can reduce your ability to conceive if you ever want to get pregnant again. Was this health fact helpful? [Insert Like/Dislike button]
79. Health facts: Benefits of quitting	Research suggests that stopping smoking appears to slow down the onset of dementia. Was this health fact helpful? [Insert Like/Dislike button]
80. Health facts: Benefits of quitting	Stopping smoking can help wounds heal better. Was this health fact helpful? [Insert Like/Dislike button]

Appendix F-16: Content specification of the 'Face-to-face support' experimental intervention module in SmokeFree Baby

'Face-to-face' module – Minimal version
One of the most effective ways of stopping smoking is by getting support from an expert stop smoking advisor. Depending on your personal preference, you can receive one-to-one counselling, group support and telephone support to help you quit. If you live in the UK, you can get any of these for free. You can book an appointment at your local stop smoking service via phone or email, or you can also get a referral from your midwife or GP.
'Face-to-face' module – Intensive version
'Local services'
Would you like to speak with a stop smoking advisor? If you are in England, call 0800 022 4332 [Insert quick dial from module] or the NHS Pregnancy Smoking Helpline 0800 1699 169 [Insert quick dial from module] [Insert link to a external site: http://www.nhs.uk/smokefree/help-and-advice/local-support-services-helplines] In Wales call 0800 085 2219 [Insert quick dial from module] [Insert link to a external site: http://www.stopsmokingwales.com/find-support-near-you] In Scotland call 0800 848 484 [Insert quick dial from module] [Insert link to a external site: http://www.canstopsmoking.com/local-help] In Northern Ireland call 0808 812 8008 [Insert quick dial from module] [Insert link to a external site: http://www.want2stop.info/cessation-services/cessation-services] In the USA call 1 800 784 8669 [Insert link to a external site: http://www.smokefree.gov] In Australia call 13 78 48 [Insert link to a external site: http://www.quitnow.gov.au] In New Zealand call 0 800 778 778 [Insert link to a external site: http://www.quit.org.nz In Canada call 1 877 513 5333 [Insert link to a external site: http://www.smokershelpline.ca] In Ireland call 1 800 200 700 [Insert link to a external site: http://www.cancer.ie]
'Pro Advice'
Specialist stop smoking pregnancy advisors will explain what face-to-face support involves and they will share their thoughts and feelings about stopping smoking during pregnancy with you.

'Face-to-face' module – Intensive version
(Appx. F-16 continued)

'Tip of the Day'	
1. Tip of the Day: First session	You don't need to prepare anything for your first appointment. Just show up with an open-minded attitude and be willing to work together with your advisor to help you quit smoking for good. Was this health fact helpful? [Insert Like/Dislike button]
2. Tip of the Day: Get personalized support	Your stop smoking advisor will ask you about your smoking habits, whether you have tried to quit before and what motivates you to stop smoking now. This information will be used to personalise the support to match your needs. Was this health fact helpful? [Insert Like/Dislike button]
3. Tip of the Day: Get nicotine replacement products	Your stop smoking advisor will recommend nicotine replacement products to help you cope with withdrawal. He or she will explain how these products can help you and how best to use them. Feel free to raise any questions or concerns you might have. Was this health fact helpful? [Insert Like/Dislike button]
4. Tip of the Day: Get home visits	For pregnant women, home visits are also available on request, so you don't need to worry about travelling to your local stop smoking clinic. Talk to your advisor and arrange your next appointment at your home. Was this health fact helpful? [Insert Like/Dislike button]
5. Tip of the Day: Get help	Research shows that getting support from a stop smoking advisor can increase your chances of successfully quitting during pregnancy. Was this health fact helpful? [Insert Like/Dislike button]
6. Tip of the Day: Book an appointment	It's never too late to change your mind about getting face-to-face support from a stop smoking advisor. Even if you decided not to get support at first, you can always ask your GP or midwife for a referral to your local stop smoking clinic, or contact them yourself. Was this health fact helpful? [Insert Like/Dislike button]
7. Tip of the Day: Stop smoking advisors	There are lots of myths out there about stop smoking advisors. Regardless of whether you attend one-to-one sessions or group support, an important thing to remember is that stop smoking advisors won't give you a lecture and tell you off for smoking during pregnancy. Instead they will encourage you to do everything you can to quit as soon as possible. Was this health fact helpful? [Insert Like/Dislike button]

'Face-to-face' module – Intensive version *(Appx. F-16 continued)*	
'Tip of the Day' *(continued)*	
8. Tip of the Day: CO monitoring	Stop smoking advisors will regularly test each pregnant woman's carbon monoxide (CO) level at the appointments. This is done because CO is a poisonous gas, which represents a serious risk to the unborn child. Was this health fact helpful? [Insert Like/Dislike button]
9. Tip of the Day: CO monitoring	When you do a carbon monoxide (CO) test at your face-to-face appointment, you will be asked to take a deep breath and then blow into a machine for 10-15 sec. It will give the result instantly and the number on the screen will tell you how much CO is in your system. Your stop smoking advisor will explain what the readings mean for you and your baby. Was this health fact helpful? [Insert Like/Dislike button]
10. Tip of the Day: CO monitoring	Your stop smoking advisor will give you feedback on your carbon monoxide (CO) readings while you're stopping smoking and explain how changes in your CO level affect your baby. Was this health fact helpful? [Insert Like/Dislike button]
11. Tip of the Day: CO monitoring	If you have a high carbon monoxide (CO) level, your advisor will try to find out why so they can give you advice on ways to lower it. It might be because you still smoke cigarettes, or that you've been exposed to other people's tobacco smoke. In some cases it can be due to a gas appliance in your house. Was this health fact helpful? [Insert Like/Dislike button]
12. Tip of the Day: Forms of support	There are different forms of support available within the stop smoking services in the UK. You can choose from one-to-one support, group support and telephone support depending on your personal preference. Was this health fact helpful? [Insert Like/Dislike button]
13. Tip of the Day: Forms of support	One-to-one appointments usually take place at stop smoking clinics in a relaxed and friendly environment, but you can get support at GP practices, pharmacies and community drop-in services as well. Was this health fact helpful? [Insert Like/Dislike button]
14. Tip of the Day: Forms of support	The free stop smoking services in the UK provide expert advice and techniques to help you. They give you the option of using nicotine replacement products to help you manage your cravings and withdrawal. Was this health fact helpful? [Insert Like/Dislike button]

'Face-to-face' module – Intensive version *(Appx. F-16 continued)*	
'Tip of the Day' *(continued)*	
15. Tip of the Day: Stop smoking sessions	At face-to-face appointments, your stop smoking advisor will ask how you are getting on with stopping smoking since your last visit. It gives you the opportunity to discuss what has been going well and what has not been going so well, so she or he can give you further advice. Was this health fact helpful? [Insert Like/Dislike button]
16. Tip of the Day: Stop smoking sessions	You will have weekly appointments with your stop smoking advisor for at least six weeks. Appointments will be scheduled before your quit date, on or around your quit date (usually within 2 weeks of your first visit) and after your quit date. Was this health fact helpful? [Insert Like/Dislike button]
17. Tip of the Day: Stop smoking sessions	Everything you discuss with your stop smoking advisor is strictly confidential and they won't share any information with anyone. Was this health fact helpful? [Insert Like/Dislike button]
18. Tip of the Day: One-to-one support	If your partner or any of your family members want to quit smoking, you can all get support at the same time from your stop smoking advisor. Was this health fact helpful? [Insert Like/Dislike button]
19. Tip of the Day: One-to-one support	At one-to-one sessions, your stop smoking advisor would focus solely on you to understand your feelings, motivation and any barriers you might face when you're trying to quit smoking. Was this health fact helpful? [Insert Like/Dislike button]
20. Tip of the Day: Group support	At group sessions, everyone sits in a circle and shares their thoughts and feelings about stopping smoking. It's really just a friendly discussion between people who are in a similar situation and a stop smoking advisor who is there to help. Was this health fact helpful? [Insert Like/Dislike button]
21. Tip of the Day: Forms of support	There're a lot of things going on when you're pregnant, and sometimes it might be too challenging to commit to weekly face-to-face appointments for at least 6 weeks. The stop smoking services offer you a variety of options: appointments after working hours, home visits on request, telephone support and drop-in clinics in your area. Was this health fact helpful? [Insert Like/Dislike button]
22. Tip of the Day: Group support	Group support involves a number of pregnant women (group size can vary) and a stop smoking advisor meeting every week to talk about stopping smoking. Was this health fact helpful? [Insert Like/Dislike button]

'Face-to-face' module – Intensive version *(Appx. F-16 continued)*	
'Tip of the Day' *(continued)*	
23. Tip of the Day: Group support	Group sessions are very informal. Your stop smoking advisor won't lecture you, instead they will encourage an open discussion about everyone's experiences with stopping smoking and ways in which each person can find ways of quitting successfully. Was this health fact helpful? [Insert Like/Dislike button]
24. Tip of the Day: Group support	Group support offers you a friendly and non-judgemental environment where you can freely share your feelings with others and learn from their experiences with quitting smoking. Was this health fact helpful? [Insert Like/Dislike button]
25. Tip of the Day: Group support	The single purpose of group support is to help you quit smoking. You will be discussing things that you can do to achieve this goal, but stop smoking advisors will not pry into any other aspects of your personal life. Was this health fact helpful? [Insert Like/Dislike button]
26. Tip of the Day: One-to-one support	At one-to-one sessions, your stop smoking advisor will give you personalised advice and encouragement every step of the way. Was this health fact helpful? [Insert Like/Dislike button]
27. Tip of the Day: One-to-one support	If your partner smokes, this is the best time to quit together. You're welcome to invite your partner to one-to-one appointments. Some people find this very helpful, others prefer to visit their stop smoking advisor on their own. It's up to you! [Insert like/dislike buttons]
28. Tip of the Day: Quit date	You won't need to quit smoking immediately after your first appointment. Your stop smoking advisor will ask you to think about the best time to stop and will encourage you to set a quit date within 2 weeks. Was this health fact helpful? [Insert Like/Dislike button]
29. Tip of the Day: Quitlines	Quitlines are free telephone helplines that offer one-to-one support from a stop smoking advisor. Your advisor will arrange vouchers for you to get nicotine replacement products from your pharmacy if you want to use them. Find a telephone number in the Local Services section of this app. Was this health fact helpful? [Insert Like/Dislike button]
30. Tip of the Day: Stop smoking sessions	You can get leaflets from your stop smoking advisor with additional information and tips to take home. Reading these after your face-to-face appointment will remind you about the things you discussed and it can give you extra support between sessions. Was this health fact helpful? [Insert Like/Dislike button]

'Face-to-face' module – Intensive version *(Appx. F-16 continued)*	
'Tip of the Day' *(continued)*	
31. Tip of the Day: Stop smoking sessions	Your stop smoking advisor will explain the risks of smoking and the benefits of quitting for you and your baby. Don't be shy to ask any questions if there is something that you don't understand – your advisor will be more than happy to give you further information. Was this health fact helpful? [Insert Like/Dislike button]
32. Tip of the Day: Stop smoking sessions	Your stop smoking advisor will give you tips and advice on how you can avoid being exposed to second-hand smoke. Was this health fact helpful? [Insert Like/Dislike button]
33. Tip of the Day: Stop smoking sessions	You will have weekly sessions with your stop smoking advisor who will help you through the process of quitting. They will give you advice on how to prepare for your quit date, support you during your quit attempt and give you further advice and encouragement for at least 4 weeks after you stop. Was this health fact helpful? [Insert Like/Dislike button]
34. Tip of the Day: Stop smoking sessions	Both one-to-one appointments and group sessions normally take an hour each week for at least 6 weeks. Was this health fact helpful? [Insert Like/Dislike button]
35. Tip of the Day: Stop smoking sessions	Your stop smoking advisor will give you advice on a variety of topics, including how to prepare for your quit date, how to cope with cravings and withdrawal and how to avoid a relapse. Was this health fact helpful? [Insert Like/Dislike button]
36. Tip of the Day: Stop smoking advisors	Stop smoking advisors know how difficult it is to stop smoking during pregnancy and they are really motivated to give you all the support you need to quit smoking. Was this health fact helpful? [Insert Like/Dislike button]
37. Tip of the Day: Stop smoking advisors	Stop smoking advisors have expertise in helping people stop smoking, and many of them have been trained to provide support specifically for pregnant women. Was this health fact helpful? [Insert Like/Dislike button]
38. Tip of the Day: Stop smoking advisors	There are thousands of professionals, including GPs, midwives, pharmacists, practice nurses and stop smoking advisors, who are trained to help people stop smoking. Many of them have expertise in helping women quit during pregnancy. They are ready to help you too, so why not book an appointment? Was this health fact helpful? [Insert Like/Dislike button]

'Face-to-face' module – Intensive version *(Appx. F-16 continued)*	
'Tip of the Day' *(continued)*	
39. Tip of the Day: Stop smoking advisors	Stop smoking advisors regularly receive training to make sure they are up to date with all the latest scientific evidence. Was this health fact helpful? [Insert Like/Dislike button]
40. Tip of the Day: Stop smoking advisors	The amount of pregnant women stop smoking advisors see at their clinics varies. Specialist advisors for pregnancy tend to see more, but all advisors are prepared to give you expert advice on quitting that would meet your needs. Was this health fact helpful? [Insert Like/Dislike button]
41. Tip of the Day: Stop smoking advisors	Stop smoking advisors understand the pressure on you when you're trying to stop smoking during pregnancy, and they will help you through days when you would rather give up and just have a cigarette. Was this health fact helpful? [Insert Like/Dislike button]
42. Tip of the Day: Stop smoking advisors	You will normally see the same stop smoking advisor during the course of your face-to-face sessions who will provide you with confidential and non-judgemental support for at least 6 weeks. Was this health fact helpful? [Insert Like/Dislike button]
43. Tip of the Day: Ask for a referral	When you find out you are pregnant you will probably visit your GP. Take this opportunity to discuss the options that are available for you to get support with quitting smoking and ask for a referral to a stop smoking clinic in your area. Was this health fact helpful? [Insert Like/Dislike button]
44. Tip of the Day: Ask for a referral	At antenatal appointments your midwife will discuss a lot of things with you about your pregnancy, including your smoking habits. You'll be given brief advice on stopping smoking and you should be offered a referral to a stop smoking clinic to get further help. Was this health fact helpful? [Insert Like/Dislike button]
45. Tip of the Day: Ask for clarification	When you are at your stop smoking sessions, feel free to bring up any situations in which you find it particularly difficult to resist smoking. Your advisor will help you make a detailed plan about the things that you can do to deal with these situations without smoking. Was this health fact helpful? [Insert Like/Dislike button]
46. Tip of the Day: Ask for further help	If you feel less motivated or confident about stopping smoking, or you smoked cigarettes between your appointments, it is in your best interest to discuss it with your stop smoking advisor to get further help. Was this health fact helpful? [Insert Like/Dislike button]

'Face-to-face' module – Intensive version *(Appx. F-16 continued)*	
'Tip of the Day' *(continued)*	
47. Tip of the Day: Ask others about their experiences	You can ask your friends and family about their experiences with the stop smoking services. They may be able to recommend a good advisor who really helped them. Was this health fact helpful? [Insert Like/Dislike button]
48. Tip of the Day: Be honest with your advisor	It's very important to be honest with your stop smoking advisor in order to get the support you really need. Was this health fact helpful? [Insert Like/Dislike button]
49. Tip of the Day: Book an appointment	If you get a referral to the stop smoking services through your midwife or GP, your local service will call you to book the time and date of your first appointment. Was this health fact helpful? [Insert Like/Dislike button]
50. Tip of the Day: Book an appointment	Book an appointment today at your local stop smoking service. To find out more about the nearest clinic in your area, go to Local Services in this app. Was this health fact helpful? [Insert Like/Dislike button]
51. Tip of the Day: Check your date	Have you booked already? That's great! Check the date for your next session in your diary and think about if there's anything you want to ask your advisor. Make a list of these, so you won't forget. Was this health fact helpful? [Insert Like/Dislike button]
52. Tip of the Day: Book an appointment	Stop smoking clinics are generally open Monday to Friday during working hours, but there are places where you can book your appointment after working hours or on weekends. Check the opening hours of your local services online. Was this health fact helpful? [Insert Like/Dislike button]
53. Tip of the Day: Book an appointment	Sometimes you might feel that you cannot wait until your next appointment to talk to someone, because you're having strong urges to smoke. To get instant help and advice, you can call a Quitline. Find a telephone number in the Local Services section of this app. Was this health fact helpful? [Insert Like/Dislike button]
54. Tip of the Day: Give it a try	If you're unsure about going to a stop smoking session, just think about it for a moment: what can you possibly lose?! Nothing really. It's free and after your first appointment you can decide whether you want to continue or not. Was this health fact helpful? [Insert Like/Dislike button]
55. Tip of the Day: The stage of your pregnancy doesn't matter	It doesn't matter what stage of pregnancy you are in, you can always book an appointment at your local stop smoking clinic. Was this health fact helpful? [Insert Like/Dislike button]

'Face-to-face' module – Intensive version *(Appx. F-16 continued)*	
'Tip of the Day' *(continued)*	
56. Tip of the Day: Call a Quitline	If you would like to get one-to-one support to help you quit, but don't want to meet anyone face-to-face, you can still get an expert advice on stopping smoking by calling one of the national Quitlines. Find a telephone number in the Local Services section of this app. Was this health fact helpful? [Insert Like/Dislike button]
57. Tip of the Day: Call a Quitline	Getting support from an expert stop smoking advisor via telephone is easy and convenient. If for some reason you can't or don't want to attend face-to-face appointments, call one of the Quitlines in the Local Services option in the SmokeFree Baby app. Was this health fact helpful? [Insert Like/Dislike button]
58. Tip of the Day: Call a specialist pregnancy Quitline	If you want to talk to a specialist stop smoking advisor on the phone, call the pregnancy Quitline on 0800 1699 169. The line is open daily from noon to 9pm. Was this health fact helpful? [Insert Like/Dislike button]
59. Tip of the Day: Discuss issues with quitting	After your one-to-one appointment, your stop smoking advisor might arrange to call you with extra support and encouragement. Feel free to bring up any issues you might have about quitting. Was this health fact helpful? [Insert Like/Dislike button]
60. Tip of the Day: Discuss preventing a relapse	Regardless of how close you are to your due date, you can discuss with your stop smoking advisor how to avoid a relapse after your baby is born. Was this health fact helpful? [Insert Like/Dislike button]
61. Tip of the Day: Discuss side effects of nicotine replacement products	You can discuss any potential side effects of using nicotine replacement products with your stop smoking advisor. Was this health fact helpful? [Insert Like/Dislike button]
62. Tip of the Day: Take a carbon monoxide test	Face-to-face appointments uniquely offer you the opportunity to monitor the level of carbon monoxide (CO) in your body and get an idea of how much CO reaches your baby. Was this health fact helpful? [Insert Like/Dislike button]
63. Tip of the Day: Take a carbon monoxide test	Monitoring your carbon monoxide (CO) level at face-to-face sessions gives you extra motivation to keep going. You can see your efforts paying off as the level of carbon monoxide (CO) in your body goes down after not smoking. Was this health fact helpful? [Insert Like/Dislike button]

'Face-to-face' module – Intensive version *(Appx. F-16 continued)*	
'Tip of the Day' *(continued)*	
64. Tip of the Day: Find your local stop smoking service	Stop smoking services are available across the UK, so whether you live in England, Wales, Scotland or Northern Ireland you can find services in your area. Go to Local Services in the SmokeFree Baby app and find out more. Was this health fact helpful? [Insert Like/Dislike button]
65. Tip of the Day: Get a referral to your local stop smoking service	You can get a referral to a stop smoking clinic through your GP or midwife, but you can also book an appointment on your own. To make it easier for you, we provide you with contact information in the Local Services section of SmokeFree Baby. Was this health fact helpful? [Insert Like/Dislike button]
66. Tip of the Day: Visit your local pharmacies	You can get expert advice on stopping smoking if you visit one of your local pharmacies. You can often be seen by a pharmacist without an appointment and they are usually open late and during weekends. Was this health fact helpful? [Insert Like/Dislike button]
67. Tip of the Day: Go to drop-in clinics	Drop-in clinics are available at various community venues, such as children's centres, where you can get one-to-one support from a stop smoking advisor. Normally, no appointment is necessary, so you can just turn up at the allocated time and get free support. Was this health fact helpful? [Insert Like/Dislike button]
68. Tip of the Day: It's free!	Every smoker in the UK can benefit from a nationwide network of stop smoking services, and the great news is that it's for free for everyone! Was this health fact helpful? [Insert Like/Dislike button]
69. Tip of the Day: Get help	If you are pregnant, stop smoking advisors within the stop smoking services across the UK are ready to provide you with specialised support to meet your needs. Was this health fact helpful? [Insert Like/Dislike button]
70. Tip of the Day: Get help	You don't need to stop smoking all by yourself. You can get expert advice on how to stop smoking during pregnancy from your GP, midwife, practice nurse, pharmacist or you can make an appointment with a specialist stop smoking advisor at your local stop smoking service. Was this health fact helpful? [Insert Like/Dislike button]
71. Tip of the Day: Get help	Tens of thousands of pregnant women set a quit date with help from the stop smoking services in the UK each year, and many of them stop successfully. Research shows that those who get expert support are more likely to succeed than those who try to quit on their own. Was this health fact helpful? [Insert Like/Dislike button]

'Face-to-face' module – Intensive version *(Appx. F-16 continued)*	
'Tip of the Day' *(continued)*	
72. Tip of the Day: Get more information about nicotine replacement products	If you are unsure about using nicotine replacement products or don't know which product would be best for you, your stop smoking advisor can explain the benefits of each and help you choose products that suit your needs. Was this health fact helpful? [Insert Like/Dislike button]
73. Tip of the Day: Get nicotine replacement products	Nicotine replacement products are also available for pregnant women in the UK. You need to contact your practitioner, midwife, pharmacist or stop smoking advisor to get these products for free. Otherwise, you can buy them in pharmacies. Was this health fact helpful? [Insert Like/Dislike button]
74. Tip of the Day: Get nicotine replacement products	You can get nicotine replacement products from your GP, midwife, pharmacist or stop smoking advisor. They will only recommend nicotine replacement for you because other stop smoking medicines are not safe to use in pregnancy or while breastfeeding. Learn more about the different products in the Toolbox. Was this health fact helpful? [Insert Like/Dislike button]
75. Tip of the Day: Get personalized support	Your stop smoking advisor might send you text messages, if you want them to, to give you extra encouragement, especially around your quit date. Was this health fact helpful? [Insert Like/Dislike button]
76. Tip of the Day: Show up even if you relapse	Your stop smoking advisor will encourage you to attend the appointments, regardless of whether you manage to stay away from smoking. You won't be judged and your advisor won't be disappointed - they will be very pleased to see that you're doing your best and will help you keep trying. Was this health fact helpful? [Insert Like/Dislike button]
77. Tip of the Day: Talk to someone face-to-face	Face-to-face support can give you that extra human contact with an advisor who you can share your feelings with. Was this health fact helpful? [Insert Like/Dislike button]
78. Tip of the Day: Try out group support	If you are interested in meeting with other pregnant women who are stopping smoking and are probably going through the same things as you, group support is a great option. Was this health fact helpful? [Insert Like/Dislike button]

'Face-to-face' module – Intensive version *(Appx. F-16 continued)*	
'Tip of the Day' *(continued)*	
79. Tip of the Day: Try out group support	If you're not the kind of person who likes talking in front of others, don't worry, you won't be forced to say or do anything that you're not comfortable with. Group sessions take place in a friendly environment and will help you feel relaxed enough to open up about your experiences of stopping smoking. Was this health fact helpful? [Insert Like/Dislike button]
80. Tip of the Day: Try out group support	Taking part in group sessions can be a very powerful motivator to stick with your goal. People who attend these sessions tend to say that after the first couple of weeks they start to feel the benefits of giving up in this way: everyone is very encouraging and no one wants to let the group down by having a cigarette. Was this health fact helpful? [Insert Like/Dislike button]

Appendix F-17: Content specification of the 'Behavioural substitution' experimental intervention module in SmokeFree Baby

'Behaviour' module – Minimal version
Your brain links smoking with situations in which you would normally light up. For example: if you usually smoke at a bus stop you will feel urges to smoke whenever you are waiting for a bus. You will also feel powerful urges to smoke when nicotine levels in your body drop. So there are internal and external triggers that make you want to smoke. It's important to try and distract yourself from your urges to smoke. Have a think about what you can do instead of smoking. One option might be to play a game on your phone.

'Behaviour' module – Intensive version	
'Distraction Plan' [tap item for content]	
1. Tip: Come up with your own strategy	Think about the activities that you enjoy but don't remind you of smoking. Keeping busy will help you manage your cravings. Was this health fact helpful? [Insert Like/Dislike button]
2. Tip: Find a new hobby	It's probably a good time to pick a new hobby to keep yourself busy. Was this health fact helpful? [Insert Like/Dislike button]
3. Tip: Hang in there for a couple of minutes	Cravings usually only last a couple of minutes at a time. Anything you can think of to distract yourself for this period of time could help you resist the urge to smoke. Was this health fact helpful? [Insert Like/Dislike button]
4. Tip: Ask friends and family for tips	Your friends and family might have good suggestions for things that you can do instead of smoking. Was this health fact helpful? [Insert Like/Dislike button]
5. Tip: Don't smoke no matter what	The bottom line is that whenever you feel the urge to smoke do something else instead. It's easier said than done, but if you can find specific activities that keep you busy, it'll make it a lot easier to cope with the cravings. Was this health fact helpful? [Insert Like/Dislike button]
6. Tip: Do something that you enjoy	If you've found an activity that you enjoy and also distracts you from smoking, repeat it every time you feel the urge to smoke. Was this health fact helpful? [Insert Like/Dislike button]
7. Tip: Things to do at home	Why not do some housework instead of lighting up for a cigarette? Was this health fact helpful? [Insert Like/Dislike button]
8. Tip: Make a photo album	Get your digital photos printed, or use your old photos to make an album. Was this health fact helpful? [Insert Like/Dislike button]

'Behaviour' module – Intensive version *(Appx. F-17 continued)*	
'Distraction Plan' *(continued)*	
9. Tip: Do yoga	Do some stretching or yoga. You can find tutorial videos for pregnant women on the internet. Was this health fact helpful? [Insert Like/Dislike button]
10. Tip: Things to do at home	Organize your closet and pick the clothes you don't like or don't need any more. Was this health fact helpful? [Insert Like/Dislike button]
11. Tip: Cook something nice	Try a new recipe and cook something nice. Was this health fact helpful? [Insert Like/Dislike button]
12. Tip: Things to do at home	Do your laundry. It's probably not that fun, but you've got to do it anyway and it will keep you busy until the cravings pass. Was this health fact helpful? [Insert Like/Dislike button]
13. Tip: Try wearing some new make-up	Have a bit of fun trying out some new types of make-up! Was this health fact helpful? [Insert Like/Dislike button]
14. Tip: Watch a movie	Watch a fun movie to help take your mind off smoking. Invite your friends over and make an evening of it. Was this health fact helpful? [Insert Like/Dislike button]
15. Tip: Check social media	You might have noticed that you can easily spend hours browsing social media sites. Use that to your advantage now! You can post something on Facebook or Twitter about stopping smoking and get support from your friends. Was this health fact helpful? [Insert Like/Dislike button]
16. Tip: Sing a song	If you're at home, stick on some music and sing along to one of your favourite songs! Was this health fact helpful? [Insert Like/Dislike button]
17. Tip: Take a bath	Take a warm bath. Spend a bit of time making it special: find some scented candles and bath oils to create a calm atmosphere. Was this health fact helpful? [Insert Like/Dislike button]
18. Tip: Think about baby names	Thinking about potential baby names is a heart-warming way of distracting yourself from smoking. Take your time and don't forget you might need to negotiate with your partner! Was this health fact helpful? [Insert Like/Dislike button]
19. Tip: Do a puzzle	Start doing a puzzle. If you like doing these kinds of things, aim for something big this time. A 1000 piece puzzle would certainly keep you busy for a while! Was this health fact helpful? [Insert Like/Dislike button]
20. Tip: Do some exercise	Try going to an exercise class for pregnant women. Some of them might be stopping smoking as well, so you can share your experiences. Was this health fact helpful? [Insert Like/Dislike button]

'Behaviour' module – Intensive version *(Appx. F-17 continued)*	
'Distraction Plan' *(continued)*	
21. Tip: Play with your dog	If you don't feel like going out for a walk, lavish a bit of attention on your dog! Was this health fact helpful? [Insert Like/Dislike button]
22. Tip: Watch movie trailers	Check out some new movie trailers online to take your mind off smoking. Was this health fact helpful? [Insert Like/Dislike button]
23. Tip: Play a game on your phone	Find a fun game to play on your phone. There are lots of apps available for free. Was this health fact helpful? [Insert Like/Dislike button]
24. Tip: Have a manicure	Book an appointment at your local salon to have your nails done. Was this health fact helpful? [Insert Like/Dislike button]
25. Tip: Make a tea	Make a cup of tea for yourself whenever you feel bored and in need of a cigarette. Was this health fact helpful? [Insert Like/Dislike button]
26. Tip: Read a book	Start reading a new book. You might be too busy for these kinds of things very soon, so take advantage of the time you have now! Was this health fact helpful? [Insert Like/Dislike button]
27. Tip: Things to do at home	Organize your kitchen cupboards. Organising and re-organising things are perfect activities to keep you busy and distracted from smoking. Was this health fact helpful? [Insert Like/Dislike button]
28. Tip: Make a snack	Make a healthy snack - have a look online to find an interesting recipe. Was this health fact helpful? [Insert Like/Dislike button]
29. Tip: Bake something	Bake something nice for dinner – have a look online to find a new cake recipe Was this health fact helpful? [Insert Like/Dislike button]
30. Tip: Take a nap	Take a nap. Being pregnant and stopping smoking can cause restlessness, so go easy on yourself and take regular naps. Was this health fact helpful? [Insert Like/Dislike button]
31. Tip: Things to do at home	Invite a friend over to catch up. Prepare some nibbles or cakes to keep you occupied before they arrive. Was this health fact helpful? [Insert Like/Dislike button]
32. Tip: Things to do at home	Decorate your baby's room. Search on the internet for ideas then try to do little bits and pieces every time you think about smoking. Was this health fact helpful? [Insert Like/Dislike button]

'Behaviour' module – Intensive version *(Appx. F-17 continued)*	
'Distraction Plan' *(continued)*	
33. Tip: Try a new hair style	Book an appointment at your local hair salon and spoil yourself a little bit. Was this health fact helpful? [Insert Like/Dislike button]
34. Tip: Write a diary	Start writing your pregnancy diary. If this is your first baby you're more likely to have time to write longer entries. Was this health fact helpful? [Insert Like/Dislike button]
35. Tip: Things to do at home	Take a picture of your growing bump and make a new entry in your pregnancy diary. Was this health fact helpful? [Insert Like/Dislike button]
36. Tip: Learn a nursery rhyme	Learn a nursery rhyme to sing to your baby. It's not as easy as you might think: you might need to do some research on the internet to refresh your memory! Was this health fact helpful? [Insert Like/Dislike button]
37. Tip: Browse SmokeFree Baby	Check to see if any new content has been released in SmokeFree Baby. Was this health fact helpful? [Insert Like/Dislike button]
38. Tip: Take your dog for a walk	Take your dog for a pleasant walk. Regular exercise will help you stop smoking. Was this health fact helpful? [Insert Like/Dislike button]
39. Tip: Go for a walk	Put on your shoes and go for a quick walk. You don't have to go very far, the point is to keep your mind off smoking. Was this health fact helpful? [Insert Like/Dislike button]
40. Tip: Find a new playground	Find out where the parks and playgrounds are in your local area. Was this health fact helpful? [Insert Like/Dislike button]
41. Tip: Things to do outdoors	If you have children, walk with them to the playground. Was this health fact helpful? [Insert Like/Dislike button]
42. Tip: Things to do outdoors	Grow your own vegetable garden. Do some research at your local library or on the internet to help you get started. Was this health fact helpful? [Insert Like/Dislike button]
43. Tip: Have fun with your friends	Organize a day out with your friends where you can let your hair down and relax – make sure to stay away from cigarettes though! Was this health fact helpful? [Insert Like/Dislike button]
44. Tip: Go to a baby store	Go to a baby store and browse around for things your baby might like. Was this health fact helpful? [Insert Like/Dislike button]
45. Tip: Buy something for yourself	Your body is changing quite rapidly during pregnancy, so go shopping and treat yourself to some new clothes. Was this health fact helpful? [Insert Like/Dislike button]

'Behaviour' module – Intensive version *(Appx. F-17 continued)*	
'Distraction Plan' *(continued)*	
46. Tip: Go swimming	Go to your local leisure centre and have a swim. Was this health fact helpful? [Insert Like/Dislike button]
47. Tip: Things to do outdoors	Do some gardening. Planting flowers and watching them grow over a period of months can be very satisfying. Was this health fact helpful? [Insert Like/Dislike button]
48. Tip: Text your friends	Text your friends or post something funny on their Facebook or Twitter pages. Was this health fact helpful? [Insert Like/Dislike button]
49. Tip: Things to do while waiting	Call your friends or family and have a quick chat. Was this health fact helpful? [Insert Like/Dislike button]
50. Tip: Things to do while waiting	Play on your phone. There are lots of apps available for free. Was this health fact helpful? [Insert Like/Dislike button]
51. Tip: Send a message to your partner	Message your partner just telling them you really need to do something at the moment to distract yourself from thinking about smoking. Was this health fact helpful? [Insert Like/Dislike button]
52. Tip: Sort out your photos	Flip through the pictures on your phone and delete the ones that you don't like. Was this health fact helpful? [Insert Like/Dislike button]
53. Tip: Listen to music	Listen to music. It's simple, but it works for some people. Was this health fact helpful? [Insert Like/Dislike button]
54. Tip: Things to do while waiting	Reply to your emails. Was this health fact helpful? [Insert Like/Dislike button]
55. Tip: Read a magazine	If you're in a waiting room, there will be all sorts of magazines around you. If there's not a single one that you can grab, you could have a look at the online magazines on your phone. Was this health fact helpful? [Insert Like/Dislike button]
56. Tip: Things to do while waiting	Check your diary. What are the things you need to do this week? Do you have to make any arrangements in advance? Was this health fact helpful? [Insert Like/Dislike button]
57. Tip: Do a crossword puzzle	Download an application to your phone to do crossword puzzles. [Insert like/dislike button]
58. Tip: Things to do while waiting	Think about how you are going to decorate your baby's room. Was this health fact helpful? [Insert Like/Dislike button]
59. Tip: Walk instead of wait	Walk down to the next station instead of waiting for the bus/tube to come. Was this health fact helpful? [Insert Like/Dislike button]

'Behaviour' module – Intensive version *(Appx. F-17 continued)*	
'Distraction Plan' *(continued)*	
60. Tip: Plan your next appointment	Check when your next antenatal appointment is and think about how you are going to get there. Was this health fact helpful? [Insert Like/Dislike button]
61. Tip: Things to do at work	Draw something. You don't have to be a Picasso: any simple sketch would do. Was this health fact helpful? [Insert Like/Dislike button]
62. Tip: Read the news	You can quickly browse your regular newspapers or magazines until your cravings disappear. Was this health fact helpful? [Insert Like/Dislike button]
63. Tip: Make a to-do list	Make a to-do list for today or tomorrow. Was this health fact helpful? [Insert Like/Dislike button]
64. Tip: Plan your grocery shopping	Write out your grocery shopping list. Was this health fact helpful? [Insert Like/Dislike button]
65. Tip: Prepare to welcome your baby	Browse online baby shops and find out what kinds of things you will need to welcome your baby into your home. Was this health fact helpful? [Insert Like/Dislike button]
66. Tip: Things to do at work	Check your personal emails and see if there's any that you can quickly reply to. Was this health fact helpful? [Insert Like/Dislike button]
67. Tip: Think about the weekend	Think about what you'll eat at the weekend and order your groceries online. Was this health fact helpful? [Insert Like/Dislike button]
68. Tip: Think about your wish list	Start a wish list: what are the things you would like to buy for yourself and your baby. Was this health fact helpful? [Insert Like/Dislike button]
69. Tip: Things to do at work	Find a new motivational quote or picture on the internet. Was this health fact helpful? [Insert Like/Dislike button]
70. Tip: Drink some water	Go to the kitchen and have a glass of water or pop out to buy something from the shop. Was this health fact helpful? [Insert Like/Dislike button]
71. Tip: Plan a garden party	Why not throw a garden party one weekend? Make a list of all the things you would need to buy. Was this health fact helpful? [Insert Like/Dislike button]
72. Tip: Things to do at work	Do you work in an office? If so, tiding up your desk can be a useful activity to distract you from your cravings. Was this health fact helpful? Was this health fact helpful? [Insert Like/Dislike button]
73. Tip: Things to do at work	Organize the files and papers on your desk. Was this health fact helpful? [Insert Like/Dislike button]

'Behaviour' module – Intensive version *(Appx. F-17 continued)*	
'Distraction Plan' *(continued)*	
74. Tip: Things to do at work	Plan your baby shower. Who would you like to invite? Was this health fact helpful? [Insert Like/Dislike button]
75. Tip: Things to do at work	You might want to tell your colleagues that you're stopping smoking, and ask for their support during those moments when your cravings get really bad. Was this health fact helpful? [Insert Like/Dislike button]
'Distraction Quiz' [tap item for answer]	
1. How many times do babies blink per minute?	Infants blink on average less than twice a minute. This rate steadily increases up to 14-15. Adults blink 10-15 times a minute.
2. Who was nicknamed 'the saviour of mothers'?	Ignaz Semmelweis, a Hungarian physician. He discovered that childhood mortality could be drastically cut if doctors and nurses in pregnancy clinics used hand disinfectant.
3. How many babies are born each minute across the world?	We don't know the exact number, but it is estimated that approximately 250 babies are born every minute around the world!
4. Why do some pregnant women suddenly start liking different foods?	This is because the sense of smell becomes stronger during pregnancy. Our ability to taste is connected with our sense of smell.
5. What is the most common last name that babies have in England?	Smith
6. What is the most common last name that babies have in Wales?	Jones
7. What is the most common last name that babies have in Scotland?	Smith
8. What is the most common last name that babies have in Northern Ireland?	Wilson
9. Who has more taste buds: children or adults?	Children. Adults have approximately 9,000 taste buds and children have over 10,000!
10. Why do children's noses run when they cry?	A passageway runs from the tear glands in the inner corner of their eyes that leads into the nose. It is exactly the same for adults.

'Behaviour' module – Intensive version
(Appx. F-17 continued)

'Distraction Quiz'
(continued)

11. When do babies have fully developed vision?	Vision develops gradually during their first year, but it's usually well developed by 8 months. A newborn's eyes are physically capable of seeing at birth, but their brain needs to develop to process the complex visual information.
12. True or false? Babies are colour blind at birth.	False. Babies can see colour from birth - they just cannot distinguish very similar tones (e.g. red and orange).
13. Which of these senses will develop fully outside the womb first: vision, smell, hearing or taste?	The sense of smell develops the earliest, soon after birth. Taste buds begin forming early in fetal development. Hearing becomes fully mature in the first month, while vision gradually develops by the end of first year.
14. How many words do babies use in their first 1-1.5 years?	Approximately 50. These are one-word utterances and rich with meaning. Although babies can understand more than they can say.
15. How many words do babies use in their 1.5-2 years?	Approximately 300. Around this time children start putting together words into short sentences.
16. How large is a newborn's heart?	A newborn's heart is approximately the size of a plum and weighs 0.8-0.9 oz. Adult hearts are approximately the size of their fist and weigh 9-11 oz.
17. How long does it take for disposable nappies to finish biodegrading?	Approximately 500 years. So the nappies that are disposed of in 2014 will finish biodegrading in 2514.
18. Which fairy tale has the biggest number in its title?	The 'One Thousands and One Nights'. Originally, the story was started by Scheherazade, a Persian queen, who managed to avoid her execution by telling the king a series of compelling, never-ending tales every night for 1,001 days.
19. How old is the first baby in the world who was conceived through in-vitro fertilisation (IVF) today?	The first IVF baby celebrated her 35th birthday on the 25th July in 2013.
20. Where was the first baby born who was conceived through in-vitro fertilisation (IVF) in the world?	She was born at Oldham General Hospital in Oldham, England, in 1978.
21. Was the second baby in the world who was conceived through in vitro fertilisation (IVF) a boy or a girl?	A girl. The second IVF baby in the world was called Candice and she was born in Australia.
22. How large is the stomach of a one-month-old baby?	After one month, a baby's stomach is the size of a large egg. Its capacity is around 80-150ml or 2.5-5 oz.

'Behaviour' module – Intensive version *(Appx. F-17 continued)*	
'Distraction Quiz' *(continued)*	
23. How loud is baby crying?	Very loud. It is estimated that baby crying is around 110 decibels. However, there is anecdotal evidence that mums have measured their babies yelling up to 125 decibels. To give you a comparison: an ambulance siren is 120 decibels!
24. Which of our body parts usually reaches adult size first?	The head normally reaches its adult size after 1 year.
25. How large is the stomach of a one-day-old newborn?	On day 1, a newborn's stomach is the size of a cherry. Its capacity is around 5-7 ml or 1-1.5 tablespoons.
26. How large is the stomach of a three-day-old newborn?	On day 3, a newborn's stomach is the size of a walnut. Its capacity is around 22-27 ml or 0.75-1 oz.
27. How large is the stomach of a one-week-old newborn?	After a week, a newborn's stomach is the size of an apricot. Its capacity is around 45-60 ml or 1.5-2 oz.
28. True or false? Newborns have more bones than adults.	True. Adults have 206 bones, but newborns actually have more...
29. Why do newborns have more bones than adults?	Technically, newborns have more bones than adults because some of their bones aren't fused together after birth. They will fuse over time as the babies grow.
30. True or false? Newborns cannot tell the difference between their native language and a foreign language.	False. Research suggests that babies show preference for their native language, which supports the idea that important learning takes place in the womb.
31. Can babies cry in their native language?	Research suggests that a baby's cry can imitate elements of their native language. French babies were found to cry with a rising tone and German babies were found to cry with a falling tone.
32. What is lanugo?	It's the first fine hair that can be found on the fetus.
33. Why do some babies lose their hair following birth?	It's perfectly normal and happens due to hormonal changes after birth. Mums sometimes experience hair loss for the same reason.
34. What is the Moro reflex?	It's one of the primitive reflexes that normally appear up to 4-5 months after birth then disappear. In response to movement or a loud sound the baby throws back its head, extends its legs, arms and fingers, then pulls the arms and legs back in.
35. What is the rooting reflex?	It's one of the primitive reflexes that normally appear up to 4-5 months after birth then disappear. It's when the baby turns its head toward anything that strokes its mouth or cheek.

'Behaviour' module – Intensive version *(Appx. F-17 continued)*	
'Distraction Quiz' *(continued)*	
36. What is the Babkin reflex?	It's one of the primitive reflexes that normally appear up to 4-5 months after birth then disappear. The baby opens its mouth and flexes the arms when its palms are touched. Testing your baby's Babkin reflex is part of the normal pediatric check ups.